AMERICAN MACHINIST

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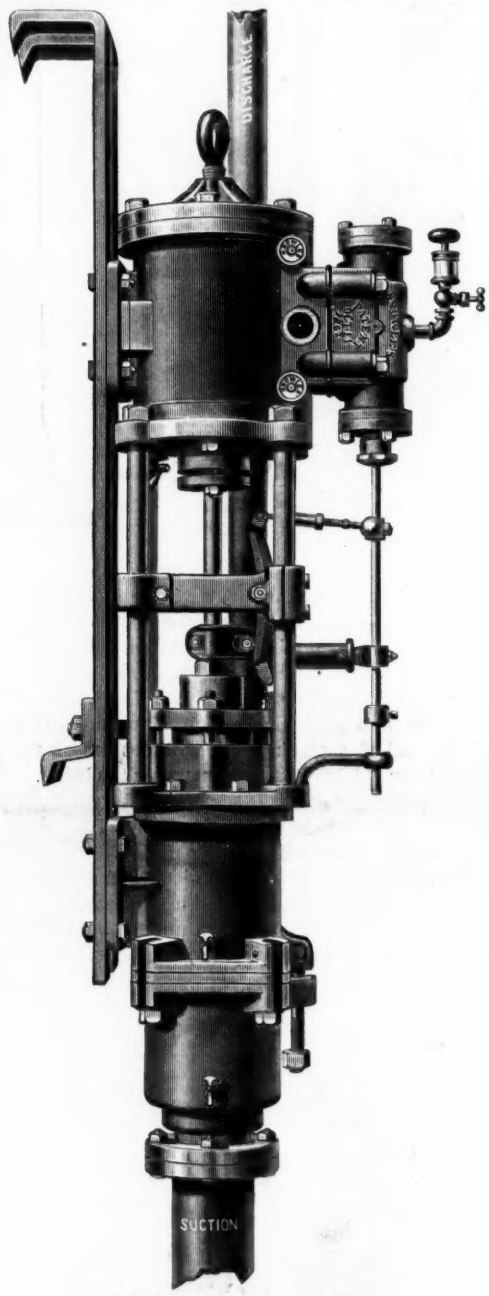
Some New Shop Tools.

On this page are shown engravings of two new machines manufactured by E. E. Garvin & Co., 139 Centre st., New York. The first of these, a cutter grinding machine, is designed for sharpening all styles of mills, reamers and face mills, straight, spiral or beveled. The revolving spindle takes the arbor for holding the emery wheel. The front slide has an arm standing out under and in a parallel line with the revolving spindle. On this arm is a sliding platform which takes an adjustable slide that holds a straight arbor, and on this is a bushing which slides freely, and the mill to be sharpened is put on this bushing and moved along under the emery wheel. By previously adjusting the adjustable finger to the tooth of the cutter to be ground, and by keeping the tooth against the finger, a perfectly true edge is secured. All necessary adjustments are provided for straight, taper, and spiral cut mills, with free backing on the cutting edge. For sharpening face mills, or those that cut on the end, there is an extra platform D, which is put in place of piece E. For solid reamers and shank cutters—arbor A is removed and C put in center. The front side is moved up and down by the hand wheel below, to adjust for diameter of mills and emery wheels. B, is an apron or shield to protect the slide and arm from emery and steel cuttings. F, is a rest which is to be used when common grinding or polishing is wanted to be done by using a larger wheel. The cone has three grades of speed. This machine is calculated to do a large range and variety of work of its kind, and will take mills from ½" to 7½ inches in diameter, and face mills to 12 inches diameter. Its weight is about three hundred pounds. The second machine shown is well arranged for taking short milling cuts, and can be operated with great rapidity. The box shaped head is mounted on a planed iron table surrounded by a trough gutter to catch oil and chips. The cross slide is adjusted by a screw that projects in front, squared for a wrench. The sliding table is operated by a hand-lever, and the motion is gauged by an adjustable stop behind. A vertical adjustment is communicated to the knee slide by means of a rack and gear, operated by a hand lever in front as shown in the cut; or, in case this convenient up feed is not required, a screw, that is operated by a hand wheel from beneath the table, is substituted in the place of the rack and gear. The spindle, which is of steel, has a $1\frac{7}{8}$ inch hole clear through it, tapered in front to receive the shank of the arbor. The boxes are made of box metal composition, and, it is claimed, are fitted up in a very substantial manner.

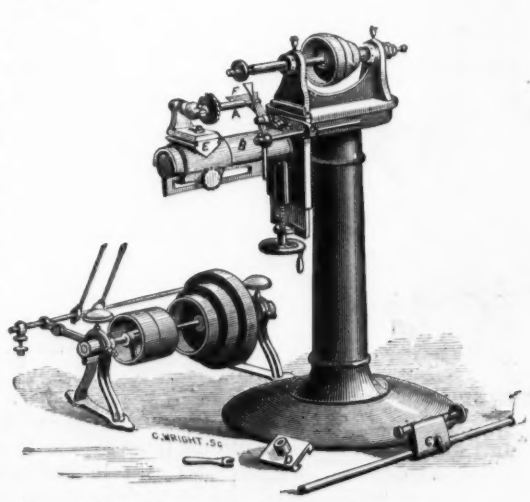
For slotting screws, a sliding vise is made, and is so arranged that the front or movable jaw tightens on the screw to be slotted, by means of two springs under the jaw. The jaw is linked so that it is operated wholly by the hand lever.

The screws are fed through under the saw.

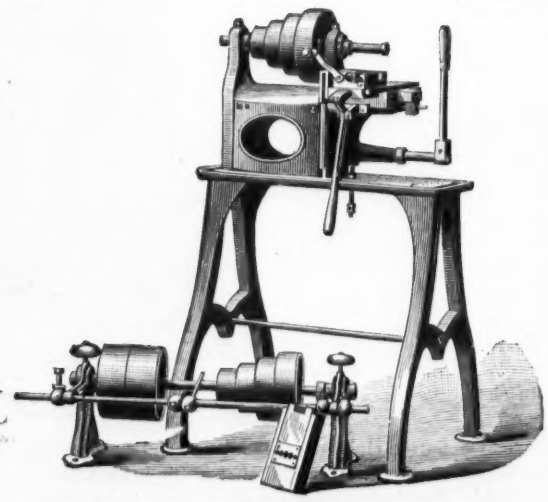
With the machine having the lever vertical motion, as shown in cut, screws can also be fed up under the saw, which greatly increases its capacity.



NEW VERTICAL MINING PUMP.



NEW CUTTER GRINDING MACHINE.



NEW MILLING AND SCREW SLOTTING MACHINE.

New Vertical Mining Pump.

The engraving herewith represents a new form of pump manufactured by the Knowles Steam Pump Works of Boston, Mass., designed for use in sinking shafts, the advantages of which will be readily seen upon examination of the cut. The pump being vertical, it occupies but little room in the shaft, and the wrought iron dogs bolted to its feet admit of hanging it in on any convenient timber after the pump has been lowered into position by means of a rope or chain attached to the ring in the steam cylinder head.

The water cylinder which is of the "Bucket Plunger" pattern is furnished with a removable cylinder barrel, which, when worn out can be at once replaced with a new one without removing the pump from its position or breaking any of its connections. It has but two water valves—one suction and one discharge—which can be almost instantly reached, and replaced when necessary.

All the metals used in the construction of the pump are chosen with a view to the greatest durability in working the bad water common to mines.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * I almost come to the conclusion sometimes that a good journal running in a good bearing, both of ample area, good material, and proper condition will run forever without wearing out. And sometimes I come to the conclusion that it will wear out. Any conclusions which I may happen to come to will have no effect on the general durability of journals, but when I consider that most everything a machinist makes turns around, I think that it don't do any harm to talk about journals, etc. If a truth is told it's all right, and if an untruth is told it's all right too, if the untruth is big enough, because thought will be directed, and a truth will develop after all.

* * * * What is an ample area for a journal? What rule should govern the sizes? One half the readers of the AMERICAN MACHINIST would answer: "The smaller the better." "The smaller the bearing the less the friction," etc., etc. A person posted in the general laws of friction will simply tell these men that their belief is false, and will often propound the simple laws of friction, and say that any experience leading to any conclusion adverse to these laws is a false experience, based on false observation. This is about all the average practical man can ever get out of the average theoretical man.

Such things as this lead the practical man to have little faith in the theoretical man. He knows very well that if he prick punches the centers in the end of a shaft he can turn it very easily with his fingers when the shaft is put in the lathe. If he prick punches deeper the shaft turns harder. If he drills and countersinks deeply, the shaft turns very hard. If he rests it in full sized bearings, maybe he can't turn it at all. He knows that an eccentric may turn very easily on a shaft before it is keyed, but that the strap moves hard on the eccentric.

He often spins a twelve inch pulley around on an inch-and-a-half shaft, but when he gets a twelve inch pulley, fitting no tighter, on a six inch engine shaft, it won't spin worth a cent. These things stick in the practical man's craw, and the assertion that a large journal has no more friction than a smaller one won't go down with him. He is certainly right, and so is the theorist who denies it without meaning to.

* * * * The "contaction" of a bear-

ing acts precisely like, and is, in fact, a friction brake applied to the surface of the journal.

The radius of the journal becomes the lever on which a resistance acts. The greater the diameter, the greater the leverage. If power be applied at a lever, the longer the lever the greater will be the resistance which can be overcome, and if friction be applied at a lever, the longer this lever the greater the power required to overcome the friction. The resistance of a journal is in direct proportion to the diameter of the journal. A six inch journal will resist motion just twice as much as a three inch journal. Journals should be no larger in diameter than strength demands, if low frictional resistance is sought for. The strains on a shaft, and the strength of the material, with proper allowance for safety give us the least diameter of a journal.

* * * * When the theorist, whom the practical man don't seem to like, says that the size of a bearing don't increase the friction, he is talking in a general way of the extent of plain surfaces, and is correct, but he will generally mislead the practical man, and thereby lose his respect. Friction does not increase with the extent of surface, but an alteration of leverage is another thing.

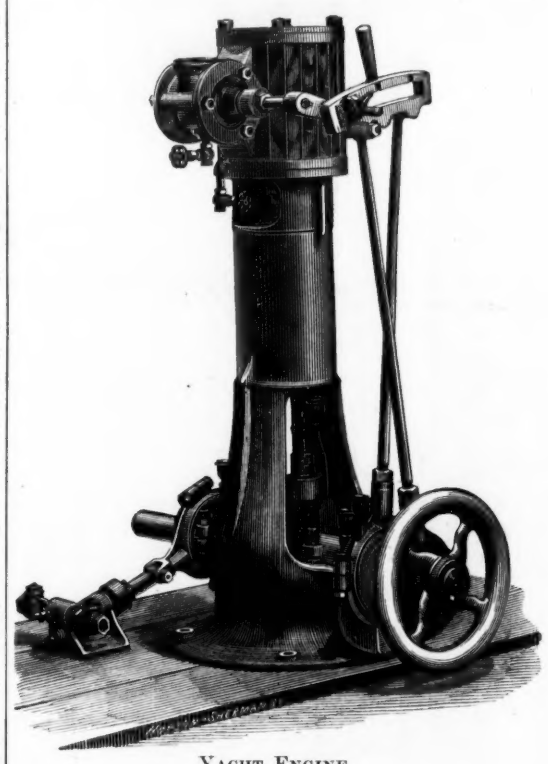
The practical man thinks he is entirely right when he is not. He thinks a long journal offers more resistance than a short one, when it does not. He thinks a board will slide easier on its edge than on its flat side, when it will not. Some one has illustrated this by a brick. It takes the same amount of power to slide a brick on the floor, whether you lay the brick on its side, on its edge or on its end. It is simply a question of weight and power required per pound of weight. Lay a second brick on top of the first and the friction is doubled, because the weight is doubled. The friction would be precisely the same if both bricks were laid side by side on the floor and moved at once, nothwithstanding the fact that in the latter case the extent of surface is doubled. The extent of surface or the length of journal has no effect on friction. If there are ten bearings on a line shaft there is a certain friction. Put ten more bearings on the same shaft and the friction is not increased. There will be just half as much on each journal as there was before, and just as much taken altogether. Increasing the number of bearings reduces the friction on each. If there is a weight of a ton on a bearing a foot long there will be the same weight on the bearing if lengthened to two feet, but the pressure will be reduced in the long bearing to half a ton per foot in length.

* * * * It won't do to have too much pressure per square inch on a bearing.

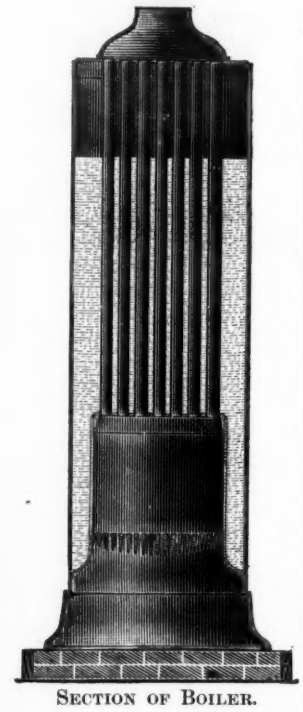
Take the brick case again. I think a brick is four by eight, or thirty-two inches area. For an even number say that it weighs thirty-two ounces, or one ounce per inch of area. This brick slides on the floor easily, and don't wear out the floor or the brick much. But pile fifteen bricks on top, and the pressure becomes one pound per inch. The thing works hard and furthermore it wears out the lower brick and the floor. If we substitute, a brick eight inches wide for the bottom one, we double the wearing surface and reduce the pressure to half a pound per inch. We can keep enlarging the lower brick until we get the pressure down to an ounce per inch, just where it was with the light load, and we noticed that the apparatus didn't seem to wear out any at that pressure. But it takes sixteen times as much power to move the sixteen bricks as it did one brick because there is sixteen times the weight.

Increasing the size of the lower brick is increasing the area of our bearing. This will save wear, but it won't save power. We must try another plan. We put buckshot under the lower brick, and, lo and behold, it don't take any more power to move the sixteen bricks than it did to move the single brick before. We have converted sliding friction into rolling friction. We keep the thing going and after awhile it begins to work hard. We investigate and find that the buckshot have become flattened somewhat. Our rolling friction is gone. We put in new buckshot, and continue to do so as fast as they give out.

* * * * After this buckshot operation goes on some time we would find out something. We would find that if we move the brick fast enough the buckshot never flatten. They revolve with immense velocity, and centrifugal force keeps them round.



Yacht Engine.



Section of Boiler.

Then we would remember that liquids are composed of minute globules just like buckshot, and we would find that some liquids were composed of fine, strong, large, durable globules, while others were weak and flimsy.

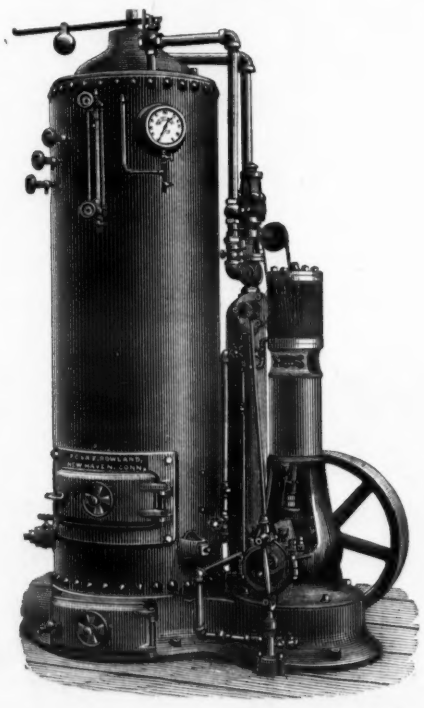
This would soon lead us into squirting liquid under the brick instead of replacing buckshot, and we find that our old buckshot was simply a lubricant after all.

* * * * The liquid we use may be oil and we can learn much by watching it closely. We find that it wears out just like the buckshot; that it gets flattened and useless, and that if we run it fast its globules hold their shape well; and if we stop they flatten right down, and let the brick touch the floor. We find that if the brick touches the floor while in motion, heat is developed and when our globules get hot they seem to melt and run together and give down entirely and let the brick right down on the floor. Now when we first found out how very easy the load moved, with the buckshot, we naturally piled on a ton of bricks and took the full benefit of the lubrication, and now we find that when this very heavy load comes down and bears right on the floor, we can't move it at all.

It gouges into the floor; our bearing gets to cutting. We did find a way to prevent wearing, and we did find a way to avoid friction, but we find that by some unskillful proportioning of things we are apt to undo all the good which is done.

We investigate and experiment, and finally determine on an oil which has a good firm solid globule, which is least affected by heat, and least liable to wear out or get smashed. Next we find a pressure per square inch which, if we look to a proper supply of fresh oil, will not smash the oil or force it out from under the brick. Next we try and find something better than brick and wood to run together.

We find that two different materials will run nicer than a single material, and maybe wind up by putting a fancy brass arrangement under the bottom brick and fixing a plain, hard steel plate for it to slide on.



Combined Engine and Boiler.

Then we are careful not to run the thing so fast as to develop so much heat that it affects the oil before it can pass off into the atmosphere.

Now we find that we have a nice cool bearing which wastes but little power in friction. But some day we will forget the oil and the brass will touch the steel, and great heat will result, and what little oil there is will become useless, and the thing will work hard and begin to cut and finally stick and stop. Then we will tear it down and find our fancy brass arrangement ruined, and some brass stuff brazed to the steel plate. We easily re-surface the steel plate but the brass concern is ruined. We make a new one.

* * * * After this thing happens two or three times a bright idea will strike us. We will see that we have made half a dozen fancy and expensive brass devices, while the simple and cheaply made flat plate has only been smoothed off once in a while.

We turn things around and make the fancy thing of hard steel and make the simple plate of brass.

Then we say: Wear out if you want to, you ain't much trouble to make new anyhow. We remember this experience, however, and ever afterwards when we scheme out journal work we are guided by this golden rule: "Always make the cheaper surface of the softer metal." We follow this rule in constructing crank pins and their bearings, main axles and their bearings, car axles and boxes, and every thing else.

We get the softer metal to wear as well as possible but are always careful that it shall not be so good a stuff to wear as the other metal. We can jack up a freight car and put a new brass in for very little money. A brass made out of hard steel would last ten times as long but the wear would fall on the axle where we don't want it.

* * * * Maybe, Mr. Editor, you have found out, from this letter, how long a bearing ought to be, but I doubt it considerably. You may find out in the next possibly, and if you do it will be because the subject is continued. Aside from the dimensions, and the materials of journals and bearings, the character of the workmanship comes in, and is often of more importance than either. I may forget the whole matter, but if I don't I won't.

* * * * Very respectfully,

Chordal.

Portable Steam Engine and Boiler.

The vertical engine and boiler herewith illustrated represents a very compact and efficient form of the application of steam power. The engine alone was fully described in the American Machinist for March, 1879, since which time some improvements have been made in the general applications.

The boiler here represented possesses some novel and valuable features. From the sectional view it will be understood that the shell is of unusual length, and the tubes used are 1½" in diameter. The sheet which forms the fire box is welded to the crown sheet, consequently there are no seams subjected to the action of the fire. These boilers are made of heavy material, and are double, machine riveted.

The engine and boiler are placed upon one base, and are furnished with a heater, pump, water gauge, and all the other necessary and modern appliances. The boilers are easily accessible by means of hand hole plates, through which all dirt and scale may be removed. These engines are well adapted for use in factories, on farms, or any place where a strong and easily managed power is required. The yacht engine, which the engraving represents, embodies all the essential features of the other "Rowland" engines, having large wearing surfaces. All parts can readily be replaced, as they are interchangeable.

The engine is furnished with a pump which is worked by an eccentric attached to the main shaft. The reversing gear is very simple, and not liable to derangement. It is so constructed that the engine may be instantly reversed. The piston rod and crank shaft are made of steel. The work is neatly finished, and put together in a workmanlike manner. On account of their simplicity, these engines do not require a skilled mechanic as engineer. All engines are thoroughly tested before leaving the works, and are economical to run. They are built by Messrs. F. C. & A. E. Rowland, New Haven, Conn. James Beggs & Co., 8 Dey street are the New York agents.

Boiler Bracing.

The Engineer-in-Chief of the United States Navy, in a recent report on experiments in boiler bracing, gives the results of some interesting trials on the strength of screw stay bolts. The average strain in pounds required to pull the 1-inch or 1¼-inch iron bolts through the ½-inch iron plate, was as follows:

WITH SUPPORTS 4 INCHES FROM CENTER TO CENTER.

1-inch bolt, not riveted	21,970
1-inch bolt, ordinary low conical head, three threads left through for riveting	25,147
1-inch bolt, button head; length of belt left through for riveting equal to 7–16 diameter of bolt	33,791
1¼-inch bolt, button head; length left through for riveting equal to one-half diameter of bolt	38,885

WITH SUPPORTS 5 INCHES FROM CENTER TO CENTER.

1-inch bolt, ordinary low conical head	22,137
1-inch bolt, button head; length left through for riveting equal to 7–16 diameter of bolt	31,282
1¼-inch bolt, button head; length left through for riveting equal to one-half diameter of bolt	35,812

The cause of the inferiority of the ordinary low conical head bolts is explained in the following way: It was observed that the bulging of the plates caused the lap of the rivet-head on the plate to commence giving way or break off some time before the maxmum strain was reached, thus leaving more for threads of the bolts to sustain. As the strain and bulge of the plates increased, the plate around the bolt turned downward and outward, until the threads in the plate almost entirely cleared those in the bolts, so that in almost every case there were only from one to two threads stripped or injured on the bolt when it drew out; therefore, it was deemed advisable to form the head in a different manner, and after several experiments it was decided that the rivet head should be made as follows: First, by having as much of the bolt through the plate as could be riveted over without injury to the iron, which was, in case of the superior iron being used, equal in length to about one-half the diameter of the bolt.

Domestic Water Power.

In Zurich, Switzerland, a portable water power, so to speak, is being extensively used for household purposes. Fire wood, for example, is sawn in convenient lengths for burning. A small sawing machine on wheels is drawn by two men to the front of a house. They connect by a flexible tube with the nearest hydrant; the water flows to the machine; the saw dances, and cuts up the wood with surprising rapidity. A portable turbine has also been invented, and employed in many places in the same city, in driving a Gramme machine for the production of electric light. Water is very abundant in Zurich; but there are other towns in which this domestic water power could be advantageously introduced. Where it is any object to keep a record of the water used, an indicator showing the quantity might be affixed to the machine.

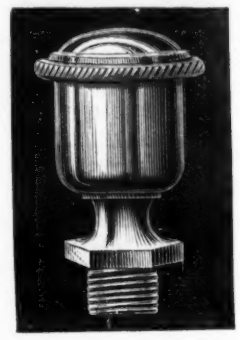
It is said that engravers and watchmakers of Germany harden their tools in sealing wax. The tool is heated to whiteness and plunged into the wax, withdrawn after an instant and plunged in again, the process being repeated until the steel is too cold to enter the wax. The steel is said to become, after this process, almost as hard as the diamond, and when touched with a little oil or turpentine, the tools are excellent for engraving, and also for piercing the hardest metal.

COATING IRON WITH IRIDESCENT COPPER—A writer in the London *Mining Journal* thinks the invention of Dr. Weil, of Paris, for coating iron and steel with copper or nickel in such a manner that the surfaces shall be iridescent, opens a large field for the employment of metal for decorative purposes. The ornamental iron castings made both in Great Britain and France are really beautiful in form and design, and by the judicious coloration of them with combinations of iridescent brass and scarlet, brass and blue, or brass and green, would produce effects which would insure their general adoption.

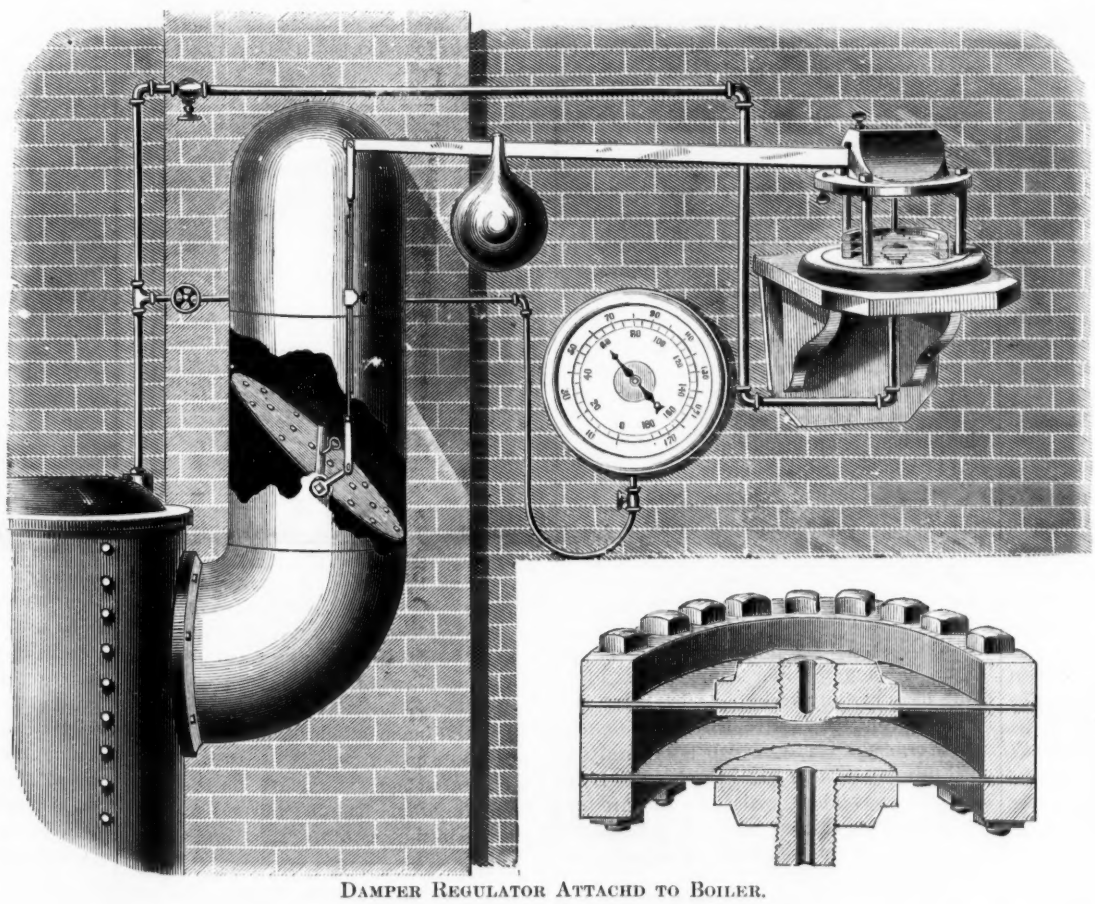
Although the locomotive builders have been turning out an immense amount of work in the past six months, says the *Railway Age*, it has been much less profitable than is generally supposed. The continual and rapid advance in the price of iron and steel has made it necessary to do much of the work at a loss.

New Oil Cup.

The new oil cup herewith illustrated was designed to supply the demand for a cheap article, which would equal in appearance and practical value the more costly patterns



of brass. This cup is made of a composition white metal, is cast in metal moulds, and is finished without any lathe or other machine work. It is nickel plated, and very nicely polished. When in place upon a machine, it cannot be distinguished from the more expensive cups. The shank is made to fit the standard ⅛th inch pipe tap. It is intended for every place where an oil cup is required for lubricating bearings, and is said to be produced at about one-half the cost of those made of brass. These cups are manufactured by Jas. D. Foot, 78 Chambers St., New York.



DAMPER REGULATOR ATTACHD TO BOILER.

Value of Expert Evidence.

The case of the Fall River Iron Works, against the Mechanics mills is developing into one of the most important law cases of the kind ever tried in this country. A great amount of expert evidence is being offered, and includes that of the most eminent men in their respective specialties to be found. It is said that the Mechanics mills have already expended in obtaining expert evidence from $4,000 to $5,000; it is estimated that the cost of trying the case averages about $1,500 every day, or more than $2.50 per minute, reckoning ten hours to the day. —*Springfield Republican.*

The merchants of Siam are showing a decided preference for American manufactures. There is a rapidly increasing demand for carriages, steam launches, tools, hardware, &c.

The Pullman Palace Car Company, after coqueting with many points, have located in Chicago, where they will erect their main works, and go into the general manufacture of cars, in addition to their own rolling-stock.

Passaic is bidding for some of the silk interests of Paterson, N. J. Fifteen lots in an eligible spot have been offered to Mr. Grossenbacher, the silk manufacturer, free of cost, if he will build a mill in Passaic.

There has been less inventive genius displayed in the production of machinery in the pottery business than in any other branch of manufacture under the sun. The creation of pottery is almost entirely dependent upon the manual skill of the operative potter, and the only improvement that has been made in 4,000 years is in the substitution of steam power for the hand and foot in revolving the "jigger" and throwing wheel.—*Mining and Scientific Press.*

DRYING MACHINE.—A machine which is capable of evaporating two tons of moisture per hour has been brought out by Mr. A. Kelly, of London. It consists of a horse-shoe furnace, constructed of seven tiers of cast-iron pipes ranging from 4¼ in. to 6 in. in diameter, and so arranged at their base that any liquid or vapor passing through them cannot go in a direct line, but must cross and recross the center of the furnace, and is thus broken up and distributed as much as possible. The waste steam from an engine or direct steam from a boiler is introduced into this furnace, in which it rapidly becomes superheated to 1,200° or 1,500° Fahrenheit. It then passes out into a kind of surface-condenser, 3 feet in diameter and 6 feet in length, containing 1,160 brass tubes 6 feet in length and ½ in. in diameter. Here the condensation of the steam takes place, its latent heat having been imparted to a current of air forced through tubes by means of a "blower" into a reservoir about 16 feet in length by 2 feet in width.

From this reservoir, and at right angles on either hand, protrude 21 five-inch perforated pipes, about 4 feet in length, and gathered together at their extreme ends into two smaller reservoirs, the object of this arrangement being to equalize the pressure of hot air in the pipes. Immediately over these pipes a wire netting, forming a table 16 ft. × 12 ft. is placed to receive the substance requiring to be dried. The steam being turned on, and the blower started, the air rapidly rises in temperature to about a mean 600° Fahrenheit. The results obtained by this machine are surprising. Oats and straw, stable-bedding soaked in water, wet hops, brewers' grains, have been perfectly dried in the course of five or ten minutes, the hops blowing about, and the straw-bedding being not only dry, but dusty. It is expected that the machine will be found extremely useful in the drying of damaged cargoes of wet cotton, jute, and numerous other materials; it is also particularly well adapted for drying waste chemical products.—*Universal Engineer.*

The *Workshop Companion* gives the following practical hints to those who carry on industrial operations involving considerable pounding: First, rubber cushions under the legs of the work bench. Chamber's journal describes a factory where the hammering of fifty coppersmiths was scarcely audible in the room below, their benches having under each leg a rubber cushion. Second, kegs of sand or sawdust applied in the same way. A few inches of sand or sawdust is first poured into each keg; on this is laid a board or block upon which the leg rests, and around the leg and block is poured fine dry sand or sawdust. Not only all noise, but all vibration and shock are prevented; and an ordinary anvil, so mounted, may be used in a dwelling house without annoying the inhabitants. To amateurs, whose workshops are usually located in dwelling houses, this device affords a cheap and simple relief from a very great annoyance.

Improved Metal Diaphragm Damper Regulator.

Our illustration herewith shown is that of Beach's improved form of automatic metal diaphragm damper regulator. The objections to most of the damper regulators in the market are: the rubber diaphragms, which from the chemical action of the water and steam, soon become hard and stiff, thus destroying the sensitiveness of the apparatus, which is very essential in point of economy. These difficulties are claimed to be fully obviated by using metal diaphragms which are made of the best spring brass, ensuring great durability and a sensitiveness which is very remarkable. This apparatus has been in use for the past eight years and is said to perform its works atisfactorily. It evidently possesses two very desirable features, viz.: sensitiveness and durability.

These regulators are made by Wood & Drake, 71 Rutgers St., New York, who will furnish any particulars required.

Venezuela has abolished her heavy duties on mining machinery.

The Calligraph.

One of the most interesting pieces of new mechanism which we have seen for some time, is the new writing machine, illustrated herewith, called the Calligraph.

Writing-machines have been before the public for several years. Like most new inventions of real value, they had when first introduced many defects. The most salient of these, however, were quickly remedied, and they have since been steadily progressing in excellence and gaining in favor with the writing public.

About three years ago they had become sufficiently perfect to make them a practical success, and, since that time, have gone rapidly into use with all classes of business men.

The calligraph is the outgrowth of years of experience and much thought, which has been bestowed upon the subject of writing machines by able inventors. In it some of

the defects of former machines seem to have been overcome. Its advantages over former machines, consists in its simpler, lighter, yet stronger construction; in its adaptability to a far wider range of work, and in its increased speed and ease of operation.

The writing is done, as with the old machines, by touching letter-keys which operate as letters, like the keys of a piano, and raise small bars tipped with types to print on the paper which is held by a carriage above them. The type-bars, which correspond in number and letters with the letter-keys, are arranged in a circle and strike at a common center; and the same key-touch which raises one of them carries the paper carriage forward the space of one letter. The large space-keys at the right and left of the letter-keys make the spaces between the words. After a line is written, the machine instantly shifts the paper for the next line; thus the writing progresses.

To form some idea of the speed of the calligraph, one might suppose himself able to take a pen in each hand, and to write with both hands at the same time; and then suppose that each motion of the pen made a complete letter, instead of requiring from three to seven motions to form one letter. Again, its speed may be calculated by seeing how fast one can tap any object with the index fingers and then supposing that each tap forms the most difficult letter. The utmost a good penman can accomplish in continuous writing, is an average of twenty-five words per minute, or fifteen thousand words in ten hours, and this is accompanied with great fatigue. It is claimed that the average operator on the calligraph can easily write from forty to sixty words per minute, and forty-five thousand words have been written with it in ten hours without fatigue.

That there is a wide field of usefulness for this machine will be seen at once. To the over-worked writer it offers a saving of time, and, what is perhaps of more importance, practically eliminates the toil and fatigue of writing. It furnishes the minister with legible sermons, which can be read from the pulpit without tiring the eyes; to lawyers and all who require manifold copies it is of great value, as from one to twenty can be taken at one time; and to thousands of intelligent young men and women it offers an easy method of gaining a respectable livelihood.

We are informed that thus far the demand for young lady operators—who really become the most proficient in its use—has always been in excess of the supply. Finally, it must prove useful to all classes of business men who value time. Apparently it is not difficult to acquire facility in using the calligraph, as the proprietors claim that by devoting one hour per day to practice, any person of ordinary intelligence will at the end of a month be able to write faster with it than he can with the pen. The calligraph is manufactured by the American Writing Machine Company, West 31st street, New York.

New Lifting Jack.

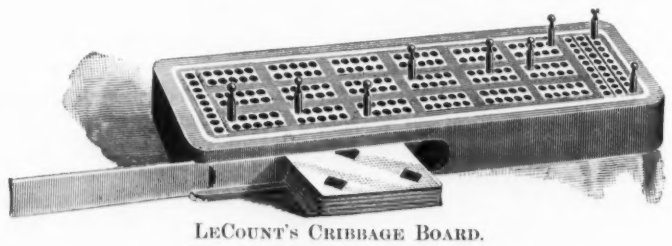
The accompanying illustration represents the Stevens new combined screw and lever-lifting jack, which is intended for general work where a jack is required. It consists of a round base with a screw attached to it, the object of the screw being to adjust the jack to different lengths. A weight may be raised by setting the jack properly and working the lever. To lower the weight all that is necessary is to reverse a catch and work the lever as in raising; or when there is no weight upon the jack it may be lowered instantly. The screw and lever combination may be readily understood from the engraving. All its bearings are made of steel, it may be operated at any angle, and is rapid in operation.

A New Cribbage Board.

Amusement, in a proper sense, is just as much a duty as work. To be sure, work is the more pressing duty of the two, being the foundation upon which the duty of amusement rests. No man who needs to work, and does not, has any right to amusement. The man who works has a right to amuse himself and others, after work is done, but not to the prejudice of his ability to work with the best results. Playing seven-up in a saloon, whether before, during, or after work hours, is to be condemned, as there is no good in it, and no good can ever come from it. For machinists, a pleasant game of cribbage at home with wife or children in the evening is greatly to be preferred, as it is an interesting game in which skill has abundant room for exercise.

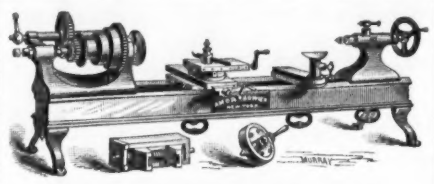
Mr. C. W. Le Count of South Norwalk, Conn., to whom machinists are indebted for many useful lathe attachments, has recently, in a humorous mood, invented and patented a new cribbage board, which is certainly a good thing to have in any household. It is neat and convenient, will score for three or six players, and keep tally of the games, having safe compartments for two packs of cards, and for nine pins.

Last Saturday, says the *Waltham* (Mass.) *Free Press*, one of the hands in the machine shop of the watch factory was sent by seven of his shopmates to Boston to purchase for each of them a set (5 vols.) of Macaulay's History of England, and adding one set for the one who was sent, makes eight sets (40 vols.) in all, which shows what style of men are found in a machine shop, and may be the secret why the American Watch Company, with such workmen, outstrips the rest of the world in its machinery.



LECOUNT'S CRIBBAGE BOARD.

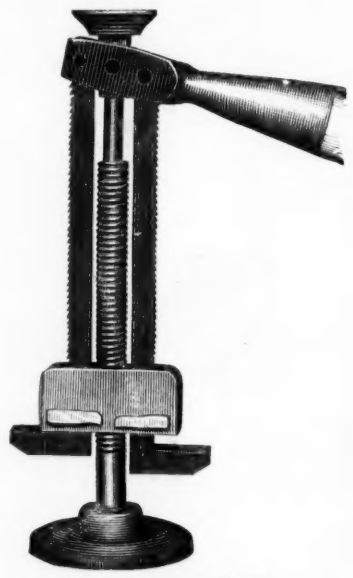
A farmer away down in Maine married a love of a school girl who didn't know the first thing about housekeeping or farming. When he took her home she neglected her household duties and went ranging about the farm "botanizing" and studying geology. The neighbors' wives did not like her; but before they knew it she had discovered on her husband's land a mine worth $40,000.



New Back-Geared Hand Lathe.

The subject of this illustration is a newly designed, 12-inch, back-geared hand lathe, built by Amor & Bowler, 168 Centre Street, New York. The spindle has steel conical bearings ground and fitted by machinery constructed especially for this purpose. The tail stock is fitted with a steel cylinder which holds the dead center, and is ground and fitted by special machinery so as to make it adjustable for taking up all wear.

The principal screws used on this lathe are made of steel, have square threads, and are made by special machinery for that purpose. This lathe has a compound rest, and is adapted to a great variety of work. The cone pulleys used are turned both inside and out. The tail stock and T rest stands are fastened to the bed by a quickly operated cam. The bed is either four or five feet long as may be desired. This lathe is intended to carry a 1½ inch belt. It has four speeds. The tight and loose pulley is 7 inches diameter and 2½ inches face. A wooden table, one foot wide, securely attached to brackets on the bed, extends its whole length. Several of these lathes are in successful use.



NEW LIFTING JACK.

The management of the Michigan Central Railroad have decided to use under all coaches built for the road hereafter, four instead of six-wheeled trucks; the superintendent of the rolling stock of that line having demonstrated to his satisfaction that a four-wheeled truck is safer, more durable, costs less, weighs less, and, if properly constructed, a coach resting on them rides easier. It is further said that the Pullman Car Company are seriously considering using four-wheeled trucks under their sleeping coaches.

The employees of the Baltimore and Ohio railroad shops at Connellsville, Pa., numbering over three hundred men, have quit work on account of the company not complying with promised advance of wages paid prior to June, 1877.

All employees of the R. W. & O. R. R. who have heretofore received ninety cents per day, have had their wages increased to $1.

Sixty Miles in Sixty Minutes.

BY W. BARNET LE VAN.

The fast trains of the Pennsylvania and Bound Brook Railroads, between Philadelphia and New York, are now cited as the most complete embodiment of the railway progress of the time to be found in this country. The trains on the Bound Brook line run the 89.4 miles between Jersey City and Philadelphia (9th and Green Sts.) in two hours (being one mile in one minute and twenty seconds), including seven stops, the rate of speed being about 44.7 miles per hour. The distance of 88.4 miles, on the Pennsylvania Railroad, between Philadelphia and Jersey City, is accomplished in one hour and fifty-five minutes (being one mile in one minute and eighteen seconds), including one stop, the rate of speed being about 46.12 miles an hour. The distance from Germantown Junction to Jersey City, 84.2 miles, is run without stop in one hour and forty six minutes, or at the rate of 47.6 miles an hour. The best running time is made between New Brunswick and Trenton going west, and Metuchen, and Jersey City, east. During the Centennial year, a train going west, made the distance, 25½ miles, between New Brunswick and Trenton, in 26 minutes. Short distances of three miles have been run on this road near Menlo Park, going east, in two minutes and thirty-six seconds, which is at the rate of 69.25 miles per hour.

It is said that this company contemplate making the run between Philadelphia and Jersey City in *one and one-half hours*, or *ninety minutes*, which means one mile per minute running time continuously for the whole distance.

To run a train this distance in the time specified would not in itself be considered as remarkable, provided the track was always clear, but several large towns and cities are, however, scattered along the route, necessitating a material reduction of speed in passing through them, and thus time is lost which must be made up by a proportionate increase in speed on those portions of the roadway which are clear and unobstructed. This increased speed must be as great at times as 65 miles an hour.

Some of the earliest locomotives ever built have run over a mile a minute in this country, and 78 miles an hour has been made in England, and, in one case, 93 miles per hour was attained for a few miles. The Ironsides, one of M. W. Baldwin's first engines, was run fifty years ago at the rate of 62 miles an hour on the Philadelphia and Germantown Railroad. Mr. Petit, who was for years connected with Messrs. Baldwin & Co.'s establishment, ran the engine at that time, and her speed was carefully noted by Mr. Franklin Peale and others who took part in the trial.

The old Rocket, built by Robert Stephenson, in 1829, for the Liverpool and Manchester Railroad, was run, on one occasion, at the rate of 60 miles an hour; and an engine, the Liverpool, built in 1830, by Bury, Curtis & Kennedy, of Liverpool, was run 58 miles an hour with a train of twelve of the short wagons of that day. The following experimental trial trip of the locomotive "Great Western" may be interesting in this connection:

On June 13, 1846, the trial was made on the Great Western Railroad, from London to Bristol, distance, 118.25 miles and back; for the purpose of ascertaining the tractive power of the monster locomotive engine, "The Great Western." The train weighed 100 tons, and consisted of ten first-class carriages, seven of which were ballasted with iron, the other three being occupied by the directors and those interested in the experiment.

The train started from Paddington station, London, at 11 hours, 47 minutes, 52 seconds. It passed the first mile-post at 11 hours, 51 minutes, 1 second, and came abreast of the fifty-second mile (immediately after which the brakes were put on for stoppage at Didcot), at 12 hours, 45 minutes, 24 seconds, running, therefore, the 51 miles, with a rise of 118 feet, in a few seconds over 54 minutes,

or at an average speed of upwards of 56 miles an hour.

At Didcot station a stoppage of 5 minutes, 15 seconds took place. The mile-post beyond Didcot, namely, the 54th, was passed at 12 hours, 54 minutes, 27 seconds, and the 75th mile-post (just after passing which the brakes were put on for the stoppage at Swindon,) was reached at 1 hour, 18 minutes, 6 seconds, the distance of 21 miles having been passed over in 23 minutes, 39 seconds, or at the average rate of upwards of 54 miles an hour.

At Swindon station there was a stoppage of 4 minutes, 27 seconds. The 78th mile-post was passed at 1 hour, 29 minutes, 30 seconds, and the 98th mile-post, which is a short distance on the Paddington side of the Box Tunnel, was reached at 1 hour, 49 minutes, 26 seconds, the 20 miles having therefore been accomplished in 19 minutes, 56 seconds, or at upwards of a mile per minute. The train came abreast of 117th mile-post at 2 hours, 12 minutes, 3 seconds. This gives the time occupied in running the distance between the 78th and 117th as 42 minutes, 33 seconds, for the 39 miles, or something like 53 miles per hour.

The maximum speed on the down journey was obtained between the 83rd and 92d mile-post. From the 80th to the 84th mile there is a falling gradient of 8 feet per mile, and from the 85½ to about the 86½ mile there is a falling gradient of about 1 in 100, and a fall of 8 feet per mile then succeeds, and extends beyond the 22nd mile-post. The train came abreast of the 83d mile-post at 1 hour, 30 minutes, 56 seconds, and passed the 92nd mile-post at 1 hour, 43 minutes, 8 seconds, performing the 10 miles in 9 minutes, and 8 seconds, or at an average speed of nearly 66 miles per hour. The 87th and 88th miles, on a fallen gradient of 8 feet per mile, were run over at the rate of *sixty-nine* miles per hour.

The train arrived at Bristol about 15 minutes past 2 o'clock, thereby making the time occupied in starting from a state of rest, and coming to a state of rest, or, in other words, from platform to platform, 118¼ miles in 2 hours, 28 minutes, including stoppages, which averaged a rate of 50 miles per hour.

A greater speed might have been attained had not one of the boiler feed-pumps given out shortly after starting, which necessitated a reduction of the steam pressure in the boiler.

The train returned to London. Mr. Brunel drove the engine both ways.

DIMENSIONS OF THE LOCOMOTIVE.

WHEELS.

Diameter of Driving Wheels.....96 inches.
Diameter of Supporting Wheels...54 inches.
Number of Driving Wheels..... 2.
Number of Supporting Wheels... 6.

CYLINDERS.

Diameter of Cylinders.....18 inches.
Length of Stroke..... .....24 inches.

BOILER.

Number of Flues.....278.
Length of Flues..... 9 feet.
Diameter of Flues..... 2 inches.
Fire-box outside..... 5½×6 ft.
Fire-box inside..... 4 ft. 10 in. ×5 ft. 4 in.
Fire-box has a partition through the middle.
Fire-box heating surface.....169 sq. feet.
Total heating surface.... ....1750 sq. feet.
Grate surface..... ..... 20 sq. feet.

WHEEL BASE.

Supporting Wheels 16 feet apart, with Driving Wheels in the center; total length of engine... 24 feet.

TENDER.

Tender on six wheels.
Weight of Engine.....30 tons.
Weight of Tender..... .15 tons.

—*Civ. Eng. and Arc. Journal.*

The best time made by Mr. Brunel was 3 miles in ten minutes, or 78 miles per hour, or one mile in 46 seconds.

The locomotive "Watt," of the London and North-Western Railway, ran the special train which conveyed the Queen's messenger bearing the dispatches containing the decision of the American Government in the case of the "Trent" difficulty in 1862, from Holy Head to Stafford, a distance of 131 miles, without a single stoppage; the journey was made in 144 minutes, being at the rate of *fifty four and a half miles* per hour.

In 1869, a locomotive built at the shops of the Chicago and North-Western Railway, having driving wheels 5 feet 8 inches in diameter, ran a special train ninety-one miles in ninety-five minutes, of which run fifty-one miles were made in forty-nine minutes.

A locomotive built by the Schenectady Locomotive Works, in Dec. 1871, with cylinders 10×24 inches, and driving wheels 5½ feet diameter, made the run, in May, 1872, from Rochester to Syracuse, a distance of 81 miles, in 82 minutes, making one stop of six minutes at Clyde. The train ran 81 miles in 82 minutes.

In February, 1880, Alice Oates engaged a special train to carry her from Chicago to Cincinnati, so as to be on time to fill an engagement at the latter place. The train made the distance from Lima to Dayton, 72 miles, in 73 minutes, including two stops, which made the speed considerably more than a mile a minute.

For years the Great Western Railway of England was the fastest road in the world, and its express ran regularly from London (Paddington station) to Bristol, 118.25 miles, in precisely two hours, being at the rate of *fifty-nine miles* per hour.

In England the fast locomotive engines had, until recently, but one pair of drivers, and in the above case the engine had to make 210 revolutions per minute to make one mile per minute, with 8 feet diameter driving wheels. On the Pennsylvania Railroad the fast train locomotive engines have two pair of driving wheels 68 inches diameter, and have to make 300 revolutions per minute to make one mile per minute.

With coupled driving wheels, as in the case of the present Pennsylvania Railroad engines, the centrifugal force of the parallel rods becomes enormous, and is a source of great danger. Some time ago the parallel rod of an engine on this road tore loose, demolishing the cab, and tore up the roadbed for a long distance.

From the above it is evident that to run 60 *miles in* 60 *minutes continuously*, and with a reasonable degree of safety, some modifications in the constructions of the engines, as now employed, will be required in the direction of dispensing with the parallel rods, or in increasing the size of the driving wheels, as well as the amount of heating surface in the boilers, as speed is a question of power and resistance.

To run *ninety miles in ninety minutes*, as is contemplated between Philadelphia and New York, the locomotive must be capable at all times of developing sufficient horse-power to perform 70 miles in one hour. To attain this very high speed, the revolving and reciprocating parts must be fully counterbalanced, and the boiler increased in size so as to have greater evaporative power than those now in use; and the permanent way in the best possible condition attainable, and devoid of sharp curves. The greatest speed of the piston in the present engines is at times about 1200 feet per minute with a 24-inch stroke, and 68-inch driving wheels, giving about 62 miles per hour; but with driving wheels 78 inches in diameter, and the same speed of piston, the running speed would be 70 miles per hour. No more adhesion is required at high than at low speeds, assuming the load to be the same.

The following table shows the speed in miles per hour of the fast lines in Europe and America.

	Destination.	Name of Railway.	Distance between stations in miles.	Time between stations hours and minutes.	Average miles per hour including stops.
Paris	Marseilles		539	15.21	35
	Lyons		320	8	40
Berlin	Cologne		364	9.26	38½
	Magdeburg		88¾	2.07	42
Spandau to Stendal		Berlin and Hamburg	57½	1.22	42
London	Edinburg	Great Northern	397	9.30	42
	Plymouth	London and South Western	246½	6.15	42
	Holyhead	North Western	268	6.35	43
	Swindon	Great Western	77¼	1.27	53½
	Rugby	North Western	82¾	1.42	48½
	Leicester	Midland	99	2.13	44½
	Peterboro'	Great Northern	76¼	1.32	50
New York	Philadelphia	Penn. R. R.	90	2.05	43
	Washington	" "	230	6	38
	Boston	" "	233	7.11	32
	Cincinnati	" "	757	26.30	28
	Pittsburgh	" "	444	13.30	32
	Chicago	" "	912	34.20	26¾
	Albany	Hudson River	143	4.05	35
	Philadelphia	Bound Brook	90.4	2.10	41⅓
Jersey City to Wayne Junction		" "	85.1	1.47	47.6
Js'y C'y to Germantom Junction		Pen. R. R.	84 2	1.43	49

The mean average speed of the above table is 40.4 miles per hour.

English being 46.2 " " "
French being 37.5 miles per hour.
German " 40 " " "
American " 37 " " "

From the above it will be seen that the speed of the English railways average about 20 per cent. faster than those of American trains.

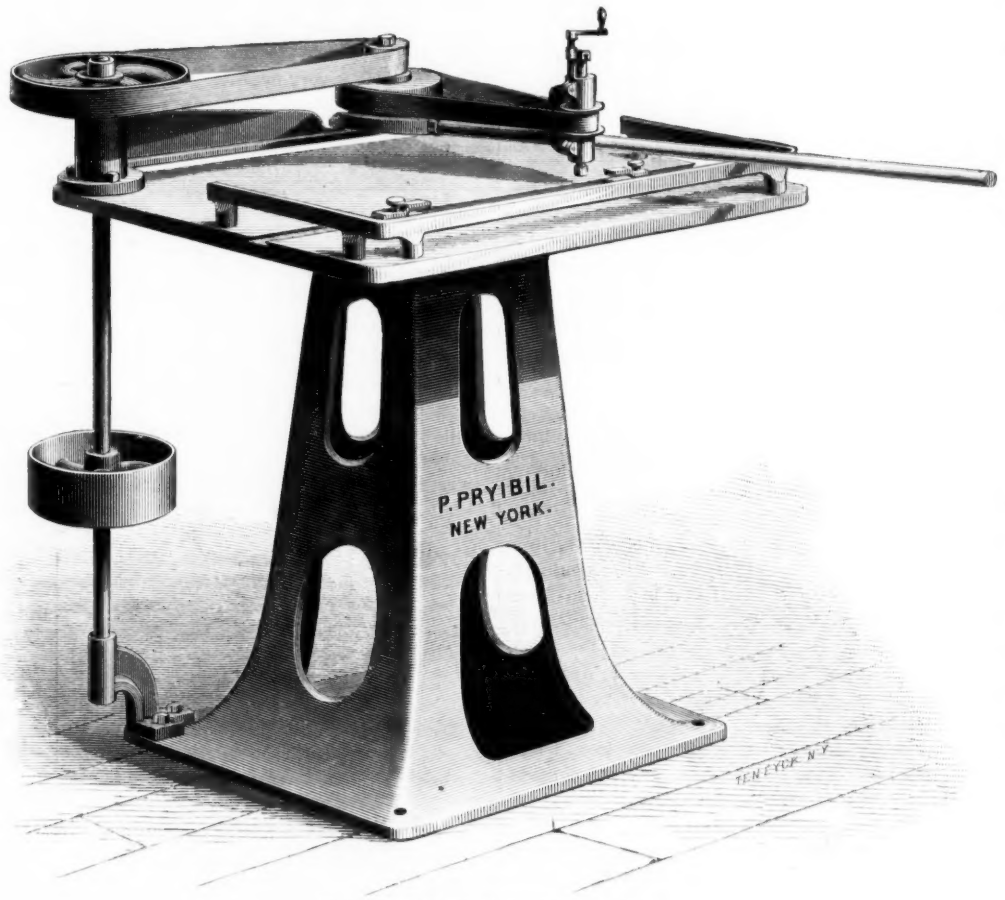
Driving wheels of 6½ feet diameter are quite as common under English engines as are those of 5½ feet in this country. The heavy express engines of the Northwestern line have 7½ feet wheels, those of the Great Western line have mostly 8 feet wheels, and some engines with 9 feet, and one of the Great Western had driving wheels of 10 feet diameter.

In regard to the destruction to the road by high speeds, Mr. Zera Colburn says: "The resistance of trains, and injuries they produce on the road, are directly as the weights; and, on the other hand, are nearly directly as the speeds." Several authorities have propounded the doctrine that the resistance and wear and tear are as the *square* of the speed. This is, indeed, generally believed. It is only true, however, when the power expended and injury done in a given period of *time* are considered. The actual *momentary* resistance and the consequent total wear, are only about directly as the speed. A part of the entire resistance is constant at all velocities; the remainder increases as the square of the velocity. Of the whole resistance, the proportion, which increases as the square of the velocity, is much greater on a *bad* than on a *good road.*

According to the experiments made by D. Gooch, locomotive superintendent of the Great Western line of England, on a straight and level track, the resistances increased in a less ratio than that of the simple velocity, at speeds of from 13 to 62½ miles per hour.

There is no doubt but that inside of five years the distance between Philadelphia and Jersey City will be accomplished in one hour.

The writer understands that the Baldwin Locomotive Works have just constructed an engine specially designed to answer the requirements of exceptionally high speeds, and its performance will serve to afford additional data of value in the consideration of the subject.



PRYIBIL'S NEW ROUTING MACHINE.

Pryibil's Routing Machine.

This machine is adapted to stereotypers', electrotypers' or engravers' use in cutting out the blank spaces in plates or blocks.

To a corner of the table is bolted a flanged sleeve, acting as a bearing for both the upright shaft and the light but strong swinging cast-iron arm, which is connected by an universal joint to the lever carrying the spindle head and cutter, which through the motions of arm and lever can be readily moved in any direction, a rest at the edge of the table maintaining the lever always parallel therewith. A spring attachment for keeping the cutter off the work until depressed is furnished when ordered; but the solid rest is recommended as being the safer and more convenient.

The spindle pulley is fixed to a sleeve which runs in bearings provided with means for taking up the wear, and the spindle which runs at about 8,000 revolutions per minute has a vertical adjustment in the sleeve of 1⅜ inches, enabling it to be used on either mounted or unmounted plates, an important advantage, as it is often found after mounting that plates have been insufficiently routed. For the same reason the clamps are made double faced and reversible, fitting both kinds of work. The table being unobstructed by rolls or supports of any kind for the cast-iron arm, with the exception of the sleeve bearing above mentioned, it will take on a plate 24×32, which can be completely routed without being shifted more than once.

The manufacturer of this machine is P. Pryibil, 461 West 40th St., New York.

Friction—Its Causes and Effects.

BY FRANK C. SMITH. (V. HOOK.)

Friction in machinery is resistance offered to motion, arising from the inter-locking of minute projections and depressions in the working surfaces. Human agency cannot produce a surface that, under the microscope, does not present these projections and depressions. The finest cambric needle, under the above conditions, looks like a moth eaten crow-bar, so to speak. The best machine is that one that, accomplishing the result for which it was designed, charges the least toll of the original power for its passage through it. Oils, etc., reduce friction, because they fill up the depressions, thus preventing the projections from inter-locking, in fact, preventing actual contact by floating the surfaces apart. In Fig. 1 the surfaces of B C, are in actual contact, and it is evident that to draw B, either right or left a resistance will be met due to the inter-locking of the surfaces.

In Fig. 2 the oil A A, has been introduced between B and C, floating the surfaces apart and reducing the friction by preventing the projections from touching each other. The oil, in any case, must be suited to it. Thus, light sewing machine oil would not do for the driving boxes of a locomotive, because of its thinness. It would be forced out of the depressions in the bearing by the weight. Engine oil applied to a sewing machine would add to the friction, because of its thickness, body and cohesion. Therefore, heavy bearings require a heavy oil, which will, by its consistency and cohesion, in and of itself, retain its position on the wearing surfaces. The poetry of friction is beautifully illustrated in the transmission of power by frictional contact, the depressions in the face of one wheel fitting over the projections of the other, like a pair of gears. Locomotive engineers have frequently noticed the fact that an old pair of driving wheel tires, when worn so as to fit the entire top of the rail, are not as effective as when the tire comes into contact in but a small portion of its surface. The reason is that, when the entire surface of the tire comes into contact with the rail, it is prevented by a minute covering of dirt, etc., from forcing its surface into actual contact. Sand is, therefore, necessary to grind away this covering of dirt. When, however, but a small portion of the tire comes into contact with the rail, having the same weight on it as before, it, by virtue of this extra weight on a small surface, forces the dirt, etc., out, and interlocks by actual contact with the rail.

When a bearing runs dry, abrasion or cutting occurs, because the projections are allowed to interlock, and the stripping off of these projections, like the teeth of the gear, is "cutting."

Cutting progresses so rapidly when once commenced, because the original projections on the wearing surfaces are much smaller and finer than those which result, or are secondary to the tearing off of the first.

Thus, being larger, more metal is removed. Babbitt metal, brass, etc., are well adapted for bearing, because these projections, being soft, rivet down, or burnish over instead, stripping off, presenting a smoother surface. If the builder of the first locomotive who geared his engine into a rack laid under the engine between the rails, had examined with a microscope the smooth surface of a driving wheel and rail, he would have found a much more efficient gear and rack than he could have constructed. He carried out on a larger scale nature's idea.

Morin and Coulomb are accepted authorities on friction, and their investigations have established the law that friction does not increase with increased surface, the weight or force pressing the surfaces remaining the same. Thus, a brick-shaped piece of metal would offer the same frictional resistance, whether drawn on its edge or side, the surface being twice as great in the latter case. When drawn on its side, the greater surface prevents the inter-locking of the faces to the same extent that occurs when drawn on its edge, but the greater surface inter-locked offers the same resistance as the lesser surface more deeply in contact.

It is plain, therefore, that a heavier oil would be needed in the latter case to prevent contact. The increase of velocity, merely, does not increase friction. This is, however, dependent greatly on secondary or incidental causes, such as resistance of the air, generation of heat, etc. Pressure alone, therefore, governs the amount of friction.

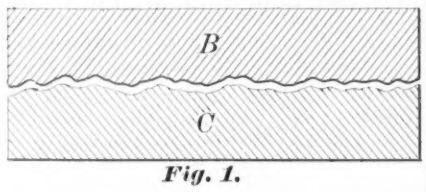


Fig. 1.

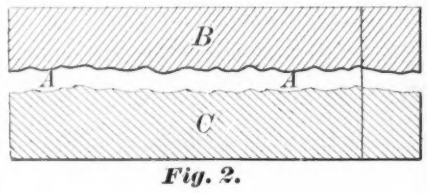


Fig. 2.

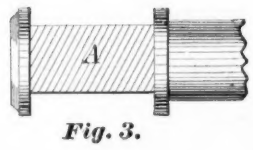


Fig. 3.

The time that surfaces are in contact, especially if such surfaces are soft, increases the frictional resistance on the start, as time allows the projections and depressions to become acquainted with each other, so to speak, and more deeply ingratiate themselves in each other's affections, by hunting up accommodating depressions to work into. Thus, an engine is "stiff" on the start in the morning, having lain idle over night, mainly from this cause.

The coefficient of friction is the relation that the power required to move a body bears to the weight of the body; thus, if a body weighing 200 lbs. is moved by a force of 50 lbs., the 50 lbs. become the numerator, and the 200 lbs. the denominator of a fraction, which represents the coefficient—that is, the 50 lbs. divided by the 200 lbs. = .25, which is the coefficient in this case, by which means the friction between different surfaces can be compared.

Crank pins, etc., heat from insufficient area; an increased area acts beneficially in two ways, decreasing the pressure per square inch, and increasing the surface to conduct away heat. The pressure per square inch of projected area, that is, that surface represented by multiplying the diameter by the length of the bearing, as A, in Fig. 3, should not exceed 800 lbs. per square inch of projected area, although recorded pressures of 1,400 lbs. and over have worked cool; these are exceptional cases, however. The pressure on the piston may be taken, as that on the pin. The main shaft bearing is made larger than the pin, because the strain on it is greater. The principle of virtual velocities comes in very neatly here. Thus, multiplying the diameter of the crank pin circle (circles being to each other as their diameters or circumference) by the pressure on the pin, and dividing this product by the diameter of the shaft, will equal the pressure on the shaft. This is plain, when it is considered that the shaft traveling through a much less given distance than the pin, and having the same force to transmit, must transmit as much greater fraction of that force through its shorter distance of travel, as its distance of travel is proportionally less than that of the pin. Having the pressure on the shaft, we may get the projected area in square inches, by dividing that pressure by 800 lbs. (or whatever the allowable pressure is to be). This last quotient again, divided by the diameter of the shaft, will give us the length of the bearing, to keep the pressure at whatever is decided on. The pressure per square inch at the cross-head and guides should be limited in the neighborhood of 175 lbs., a far less pressure being desirable.

Any means by which the heat generated in insufficient wearing surfaces can be dissipated or radiated off, will keep the bearing cool, if the pressure is not such as to cause actual contact. In the latter case, nothing but a reduction of the pressure, by increasing the area over which it is distributed, will allow of running the bearing. Any other means is a work of time, as the case has reached that point where the bearing very justly considers that forbearance has ceased to be a virtue. Before closing this article, I want to call attention to the advantages of pure plumbago as a lubricator. Refractory bearings generally succumb to it. A small quantity fed in with the cylinder oil will give a cylinder bore as smooth as a looking glass; *too much* balls up in the piston head, and, in fact, like too much of any good thing, is detrimental. I remember a locomotive cylinder that had just begun to cut slightly. The packing was slacked off, and the tallow mixed with plumbago, and, on her next trip, she was dosed with this preparation. When she next came into the house, that cylinder showed up clean and smooth, though black in color. A great saving in oil will be effected by its use, as it makes a permanent filling for the depressions in the bearings. I have only seen *one* reliable article or compound of those sold for this purpose that is free from grit, a very necessary qualification. The reason why some boxes run so wonderfully long without any oil is, that they are lubricated with plumbago.

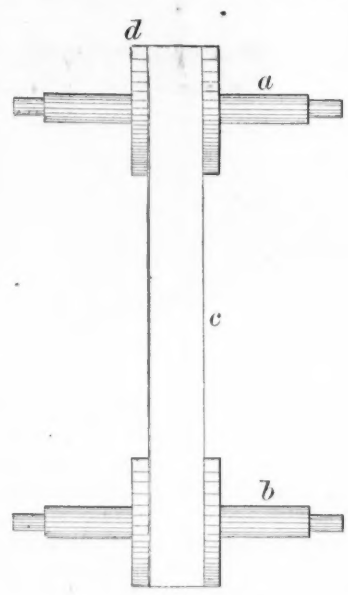
Letters from Practical Men.

QUESTION RELATING TO BELTS.

Editor American Machinist:

Let *a*, and *b*, two shafts with their pulleys, and connected together by the belt *c*.

For the sake of plainness, let us imagine them to be placed perpendicularly over one another. Let *a*, be the upper, and *b*, the lower shaft. If the end of the shaft at *a*, is



raised, the belt will run to the side of the pulley at *d*, although the opposite side of the pulley would be the highest; that is, it would be a greater distance from the lower shaft *b* (which is supposed to be level), than the side towards *d*. Replace the shaft *a*, so that they are parallel as at first.

If the end of the shaft at *b*, is now raised, the belt will run to the side next *b*. These principles apply the same, when the shafts are both on the same level, or placed one above the other as they appear in the sketch. "*The belt will run towards the ends of the shaft that are nearest together.*"

The theories put down in books, as well as some of the leading newspaper writers, say that the belt will always run towards the high side of the pulley.

I called the attention of the Editors to it; but they told me to experiment; but that is what I want them and others to do, who doubt my assertion.

What says the AMERICAN MACHINIST?

St. Louis, March 10th, 1880.

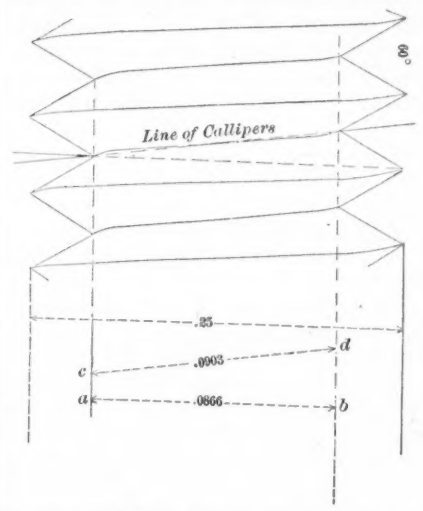
John O'Connell.

(See Running Conditions of Belts. By L. F. Lyne, issue of April 17th.)

MEASUREMENT OF SCREW THREADS.

Editor American Machinist:

In your paper of Feb. 14, among Questions and Answers, No. 4, H. C. J., you state that the diameter of the screw in question at bottom of thread is .0866, which is correct when measured at right-angles to axis



of screw and with bottom sharp, as at *a*, *b*. But as measured with a sharp pair of callipers, it would be on an angle of 8° or 9° and would measure .0903, as at *c*, *d*. The drawing will fully explain itself.

Respectfully, J. E. MCCONNELL.

Iowa City, Iowa.

CUTTING SCREWS OF METRICAL PITCHES.

Editor American Machinist:

Referring to the query of Mr. Richards, in the MACHINIST of 10th ult., as to cutting screws of metrical pitches:

The writer had occasion, a few years since, to replace a French dividing screw of one centimeter pitch. The lathe best available for the purpose had a lead-screw of $\frac{1}{8}$ inch pitch, or 3 per inch. Two driving wheels, of 93 and 127 teeth respectively, with two driven wheels of 100 teeth each, produced a thread of .3937 inch pitch.

To inquire here whether this pitch was in actual fact equal to one four-thousand millionth of the meridian circle of Paris, would only tend to perpetuate the muddle which has involved the question: "How many inches are one metre?" and which happily seems to be clearing up.

If the lead-screw has 4 threads per inch, two driving wheels of 124 and 127 teeth respectively, used with the same driven wheels, would produce the same result. Or, if the lead-screw has 5 threads per inch, two driving wheels of 76 and 259 teeth would result in an error of only about .00005.

It may be noted in this connection that a pitch of one millimeter corresponds very accurately to 25.4 threads per inch. If we substitute 25.5 for 25.4, the error will amount to about .004, which is not more than very many taps and dies vary from correctness in pitch after hardening.

On this approximate basis we can cut the millimeter pitch and its multiples in almost any lathe by the addition of a few wheels. 51 and 34, or 68 will be found convenient numbers, and the work will be sufficiently accurate for ordinary bolts and nuts.

Philadelphia, Pa. A. B. COUCH.

THAT MICROMETER SCREW-CUTTING PROBLEM.

Editor American Machinist:

In reply to several correspondents, we submit the following:

PROBLEM.—Given, the pitch of the guide screw of a lathe. Required, the gears to cut a screw of any desired pitch.

RULE.—Express the pitch of each by a fraction and reduce them to a common denominator. Then will the numerators be the numbers of teeth in the required gears.

EXAMPLE.—A guide screw is $\frac{1}{6}$th inch pitch, and it is required to cut one of one centimeter pitch.

$$\text{The centimeter} = .3937079 = \frac{100}{254} \text{ nearly.}$$

$$\text{Then, } \frac{1}{6} \text{ and } \frac{100}{254} = \frac{254}{1524} \text{ and } \frac{600}{1524}$$

Reducing numerators, we find the required gear, viz.: on spindle, 300, and on screw 127 teeth. Of course, any change by reduction or compounding, that does not change the proportion, is permissible.

The result is a pitch of .3937008, or .0000071 less than one centimetre, which is an error of less than $\frac{1}{1000}$ of an inch in a metre.

Respectfully,

FRANCIS H. RICHARDS.

Office of Richards & Dole, Springfield, Mass., April 12, 1880.

BLUNDERS OF A PRACTICAL MAN.

Editor American Machinist:

I notice in your issue of April 10, No. 15, a letter by H. C. Hill, of Norristown, Pa., in which he speaks of the blunders made by so-called practical men. Now, I think Mr. Hill made quite a blunder when he took this new departure in regard to working steam expansively. He says in this letter that the practical man makes a blunder when he believes what the learned M. E. whispers in his ear in favor of dead steam, or steam whose connection is severed from the boiler. Now, if this steam is dead, or without pressure, how does Mr. Hill account for the curved line on a diagram, or indicator card. Now, I claim, if his theory was correct, the steam line would suddenly drop from the cutting-off point to the atmospheric line, making what you might virtually call a square card, instead of the usual sloping from the point of cut off to the exhaust corner. Now, if Mr. Hill will take the trouble to put a gauge on a steam cylinder, beyond the point of cutting off, he will find that the steam is not dead, but very much alive, and I could go on naming any number of ways in which he could prove to himself that that steam cut-off is not dead. I would further say that I do not know of a practical man that does not believe as I do, and I claim to be a practical man, that does not believe till he is satisfied a thing is true.

Yours, etc.,

JOHN E. DONLING.

Marine Engineers' Association, Philadelphia, Pa.

Principle and Method of Calculating Gears for Cutting Screws.

BY J. L.

The relative velocities of two gears meshing with each other, or of two shafts revolved directly by two gears meshing with each other, are inversely as the number of teeth in those gears. Thus we have the following proportion:

(Velocity of gear *B*) is to the (velocity of gear *A*) as (No. of teeth in gear *A*) is to the (No. of teeth in gear *B*).

This proportion is composed of two ratios—(velocities and numbers of teeth)—which are always equal to each other; and, expressing the ratios in the convenient form of a fraction, we have the following proportion:

$$\frac{\text{Veloc. of gear } B}{\text{Veloc. of gear } A} \text{ equals } \frac{\text{No. of teeth in gr. } A}{\text{No. of teeth in gr. } B}$$

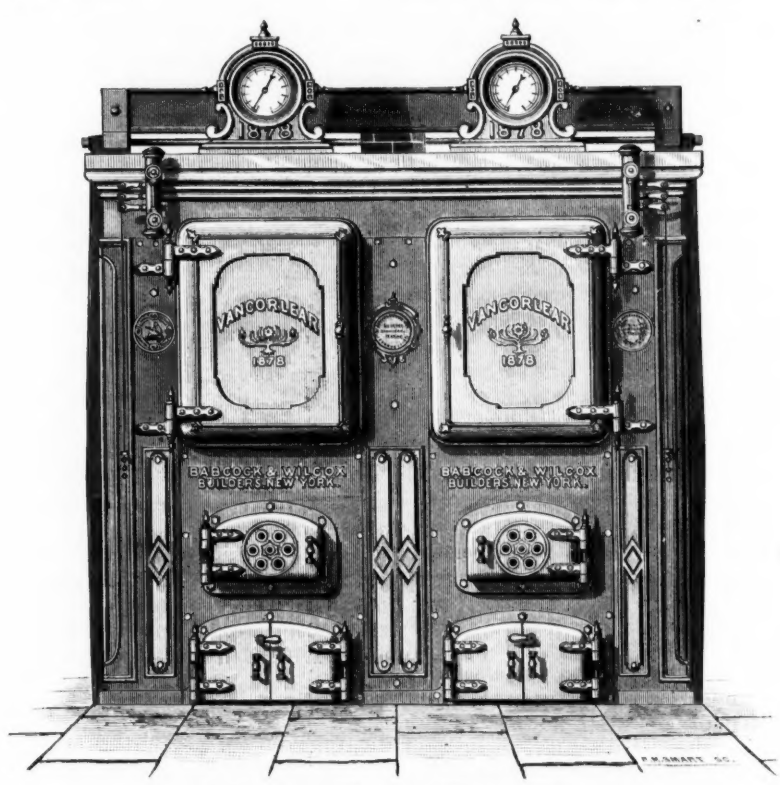
Let any one who does not readily understand this take two simple numbers, as, for example, 80 teeth on *A* and 40 on *B*. The velocity of *B* is then twice that of *A*, and the above proportion gives the correct velocity ratio, two.

We will assume the gears, which are within the head-stock and on the spindle and stud of a lathe, to have an equal number of teeth (as is usually the case). The velocities of the spindle and stud are therefore equal, and either may be taken indiscriminately, as far as velocity is concerned, although the direction of their motions are opposite.

The intermediate gear does not affect the velocity ratio between the lead screw and spindle, because the velocity which it loses from one gear it adds to the other. We have left only the lead screw, spindle or shaft to be cut (being exactly alike in velocity), having a gear on each. On a stiff carriage, it is evident that a point on the face of the lead-screw nut, or the point of an imaginary screw tool on the face of the lead-screw nut, moves forward or backward exactly as fast as the point of the screw tool in the post.

If there were six threads to the inch on the lead screw, it is evident that while the lead screw would revolve six times, the nut would have moved one inch, and the point of the tool would also have moved one inch. It is also evident that if the spindle revolves twice as fast as the lead screw (or has twice the velocity), the point of the screw tool would describe 12 helixes or threads during its inch motion. If it has three times the velocity of the lead screw, it would describe 18 threads (to the inch). If it has one-half the velocity of the lead screw, it would describe three threads during its inch motion (or three threads to the inch). Therefore, if we wish to make the number of threads on the screw to be cut greater or less than the number on the lead screw, we must make its velocity greater or less in the same proportion. This we can do by the principle enunciated in the first part of this article.

Suppose we have a gear of 30 teeth on the stud, and wish to cut a No. 12 screw, with No. 6 lead screw. The velocity of the stud or spindle must be twice that of the lead screw, and we have the following proportion for obtaining the number of the gear to put on the lead screw:



AN IMPROVED STYLE OF BOILER FRONT.

$$\frac{\text{No. of gear on stud (30)}}{\text{No. of gr. on lead screw (Ans.)}} = \frac{\text{Veloc. of lead screw (6)}}{\text{Veloc. of spindle (12)}}$$

$$\frac{30}{\text{Ans.}} = \frac{6}{12} \text{ or } \frac{1}{2} \qquad \text{Ans.} = \frac{2 \times 30}{1} = 60$$

That is, the gear on the lead screw revolving one-half as fast as the other must have twice the number of teeth.

If we wish to cut No. 14 thread, the velocity of the stud would be $\frac{1}{6}^4$ or $\frac{7}{8}$ that of the lead screw, and we would have the following proportion:

$$\frac{30}{\text{Ans.}} = \frac{6}{14}, \qquad \text{Ans.} = \frac{30 \times 14}{6} = 70.$$

If we wish to cut a No. 4½ thread, the velocity of the spindle would be $\frac{4\frac{1}{2}}{6}$ (=$\frac{3}{4}$) of the lead screw. And

$$\frac{30}{\text{Ans.}} = \frac{4}{3}, \qquad \text{Ans.} = \frac{30 \times 3}{4} = 22\frac{1}{2}.$$

But as there could be no gear with 22½ teeth, we must change the 30 gear on the stud and keep the ratio the same. Thus we can take 24, 28, 32, 36, or any multiple of 4 for the gear on the stud. And

$$\frac{32}{\text{Ans.}} = \frac{4}{3}, \qquad \text{Ans.} = \frac{3 \times 32}{4} = 24,$$

this being the number of the gear to put on the lead screw.

Revoking our previous supposition, let us suppose that the gear on the end of the stud within the head-stock has twice as many teeth as the gear on the spindle. This doubles the velocity ratio between the stud and spindle, which in our previous supposition was *one*, and therefore not taken into account. To counteract this increase, we must halve the velocity ratio between the lead screw and stud. This can be done by having twice as many teeth on the stud gear, or one-half as many teeth on the lead screw gear.

If the gear on the end of stud within the head-stock has one-half as many teeth as the gear on the spindles, then the velocity ratio between the lead screw and stud must be doubled. In all cases, the velocity ratio between the spindle and lead screw must equal the product of two ratios, namely: ratio between spindle and stud, and ratio between stud and lead screw.

Hoping that I have made this method clear and plain, I wish to make evident the importance of understanding the reason why calculations are so made, or of understanding the underlying principles, when it is possible to do so. Thumb rules and empirical formulæ are very good, as far as they go, and will, probably, always have to exist. They are made up under certain conditions, and hold true only under those conditions. If one of these conditions does not exist, or if a new condition is introduced, the person who uses them, because he don't know enough to use a principle, will surely not know enough to change the rule or formula to suit the new conditions. In all probability, he will not think of such things as *conditions*, and, as a consequence, reach a wrong result. There are also other objections to rules. A principle can easily be memorized and carried in the head, while rules must be on paper or in books. An attempt to memorize rules, will almost invariably result in getting some part of the rule wrong.

To illustrate, suppose you have the following thumb rules: Multiply the number of the lead screw thread by some convenient number, such as six, and the product will be the number of the stud gear. Multiply the number of thread to be cut by the same number (6), and the product will be the number of the lead screw gear. This is correct only for certain conditions. If it is required to introduce compound gearing or some other change, how is it possible to make the rule answer for such a condition?

To those accustomed to work by rules, who are desirous of acquiring the better kind of knowledge, let me suggest that they make six or more tables for screw-cutting, varying each by the number used on the stud gear, by increasing or diminishing the internal stud gear, or otherwise, according to the principle stated in the first part of this article, and thus cultivate a habit of independent thinking.

I remember once of working beside a journeyman machinist of six or more years experience, who gave me the following rule for screw cutting: "Multiply the number of the lead screw by the number of the screw to be cut, and the product will be the number of the stud gear. Multiply the number of the screw to be cut by any number, and the product will be the lead screw gear." I attempted to show him that the rule was perfectly indefinite because of the factor "any number," and according to that I could cut the same thread by having a dozen different gears on the lead screw, without changing the stud gear. And the converse ought to hold true—that if the two gears should be unchanged I could cut any number of threads just at my will. But he could not see through my logic. Master mechanics had told him the rule, and he must be right. I attempted to show him the principle. But when I said that when a No. 6 lead screw had revolved six times the carriage would have moved 1 inch, he would not admit it, because in counting the threads of a screw one thread must be dropped for every inch. After a long time I found that he didn't know what a thread was. He always counted one thread too many, and then dropped one. His counting was exactly analogous to counting the eighths of an inch by the marks on the scale, counting the mark before the first eighth, and the mark after the last eighth, thus making 9 eighths to an inch. Soon afterward he had occasion to cut a No. 10 square thread by a lathe index. After reckoning the gears by his rule and mine, and finding that his failed and mind held true, he accounted for the disagreement of his rule because a square thread was to be cut. However, about two weeks afterward it occurred to him that he had omitted one factor in giving me the rule.

Boiler Fronts.

Most men in setting boilers are liable to attach too little importance to the boiler front. In many cases it consists of a flat plate of cast iron, which sometimes has ribs for increasing the strength, and is bolted up against the brick work of the boiler. After the front has been in position for some time the bricks will shrink away from the plate, leaving it loose. This is indeed a bad style of work, and is the cause of great inconvenience. The consideration of these and other objections led to the design of boiler front which is represented by the accompanying engraving. This front is made up of sections, which are put together in a substantial manner. The corners of the brick work are entirely covered by the cast iron plate which forms a neat round corner, and extends along the sides so as to cover any opening which would otherwise appear. The fire doors are lined with a perforated plate, which, instead of admitting a body of air distributes it equally, so as to insure more satisfactory combustion. The ash-pit is furnished with doors, so as to better control the draft. The tubes or flues are easily accessible by means of large doors, shown in the engraving. The steam gauge, instead of being placed in some remote dark corner, where the engineer has to use a light to find it, is placed in a neat cast-iron frame, located upon the top of the front.

The gauge cocks are neatly attached to a water column, as shown, and in such a way that when these cocks are opened the front is not deluged with mud and water.

This front is neat in design, and the most valuable features desirable in such an appliance seem to have been anticipated. Fronts of this style as well as others of improved design are manufactured and applied by Babcock & Wilcox, 30 Cortlandt St., New York.

The oil business does not seem to be on the decline. There were 368 new wells completed in the oil regions in March which produced 6,992 barrels. In February 278 wells were completed, yielding 4,553 barrels.

There are indications that the old Boonton, N. J., water power will soon be disposed of to a company who will use it for the manufacture of paper. If the sale is effected, two or three brick buildings will be erected and about 300 hands employed.

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NEW YORK, MAY 1, 1880.

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Decline in Prices of Iron.

The recent decline of from twenty to twenty-five per cent. in the prices of iron has caused some surprise and a flutter of anxiety among many large consumers. Pig iron at the present writing is selling at furnaces in the Lehigh Valley at $32 a ton for the highest grade of foundry, and one dollar a ton less for each lower grade in a direct ratio. This is about $8 decline from the highest figures. The Western Bar Iron Association decided at their last meeting to reduce the basis price of merchant iron from four cents a pound to three and two tenth cents. It is now plain to observe that the extremely high prices reached a few months ago were likely to produce unfavorable results to producers as well as to consumers They caused importations of iron and steel from Great Britain to swell from less than 27,000 tons in the first two months of 1879 to more than a quarter of a million tons in the first two months of 1880. They also caused a serious check to the opening of extensive contracts, the cost of executing which would depend mainly upon the cost of iron. A whole year of inordinately high prices would doubtless cause the starting up of every idle mill and furnace in the country that could be put into operation, thereby bringing about the conditions for an overstocking of the market as soon as a lull in consumption should occur. Again, if all consumers were obliged to pay the most advanced prices for iron, a severe loss would be suffered in our export trade of machinery, tools and other manufactures of iron.

It is, therefore, not so much a matter of regret that prices have declined. Very few large consumers of iron have paid higher prices than those now ruling, and as many of them confidently expect a still further reduction before placing new orders, the strength of the market is likely to be satisfactorily tested. As most of the mills and furnaces are supplied with orders to absorb their whole production for some weeks to come, it is unlikely that any surprising weakness will be developed.

Opportunities of Employes.

There is a vast difference in the codes of ethics adopted by various manufacturing establishments, even though the principles exhibited in their business intercourse with the world at large may not be characterized by marked peculiarities. "Buy where you can buy the cheapest, and sell where you can sell the dearest," is a maxim closely enough followed in every-day practice, but cases may present themselves where it should be subject to flexibility. Circumstances may frequently put it into an employer's power to profit by taking advantage of an employes' necessities. If the former is one of nature's noblemen he has no hesitation in deciding to forego some measure of possible gain, rather than sacrifice any measure of of manly honor, but if (as is too often the case), he is possessed with the spirit of greed, as his predominant trait, the unhappy employe must "grin and bear it" to its full extent. A certain manufacturer wanted a particular kind of work done, which required a rare kind of professional skill. But he found it in a young man, who was qualified in a high degree to do what was required, yet was greatly in need of work, and consented to work for very small pay. The employer was elated, and engaged the man at the closest possible shave. The latter went to work with all his energy and determination, putting the best skill into his work. His employer's customers were delighted. They not only liked what he did, but they liked it so well that they would have no other. This, of course, caused the employer still greater satisfaction, for both his business and his profits were growing rapidly.

After a time the young man asked for higher pay, and was met with a refusal by the employer, coupled with the assertion that he could not afford it. The young man knew this to be false, but he kept on working, doing better and better. The employer was more elated than before. But his self-gratulation was reduced several degrees one morning, when he learned that the young man had set up in business for himself. The customers who liked his work would have no other, and the old concern could not get a man to just match his work at any price. The result was as might be expected. The employer saw his business go steadily down, and that of his former ill-paid employe go steadily up.

This case suggests the question whether it is a wise policy on the part of an employer to permit a man engaged on salary to become an indispensable factor in the business.

There might be instances where, for a time, this would seem unavoidable, but the condition ought to be changed as soon as possible. No business is safe unless its management is indisputably in the hands of its responsible proprietors. A machinery or tool manufacturer, for instance, who would trust the selling of his wares mainly to a traveling salesman employed on salary, might properly be considered an indiscreet manager. Even if no opposition to his business existed, it might be established were favorable opportunities left open. A proprietor should take into account the possibility of some of his employes starting business on their own account, without notice, at any time they may choose to do so.

A Commendable Strike.

Strikes, as a rule, are to be avoided; but upon strong provocation a strike may be commendable. The glassworkers of South Jersey have undertaken a strike against the prevailing system of receiving their pay in orders on stores owned by their employers. They want to receive their wages in money, the universal medium of exchange in business, and have given plain notice that they will hereafter decline to take pay in truck at any price employers choose to demand. The strike deserves to succeed. No manufacturer has a moral (even if he has a legal) right to compel his workmen to accept pay for their services in anything but current money. The glass manufacturers will probably contend that the truck-pay system is rendered respectable by long practice, and because the workmen have suffered it so many years they ought to bear it without change. But, we are glad to see, the workmen have come to a different conclusion and, it is to be hoped, will stick to their decision.

A New School of Applied Mechanics.

The education of young men in mechanics and engineering is every day assuming greater importance. Workmen competent to construct the fine machinery required by the highly developed state of our manufactures are comparatively rare. It is easy to obtain machinists to run a lathe, planer or milling machine, or to do vise work, but if a new machine is to be built economically and quickly, from original drawings or sketches, and started up successfully, a skillful workman is required. In some sections, hardly one in a hundred can do this acceptably. The problem is, therefore, how to increase the number of these superior workmen. There is but one way to do it. Either those now working at the mechanical trades must qualify themselves by suitable study to perform more difficult and responsible work, or those young men now entering upon the business must be much more carefully educated in both theory and practice. With this purpose in view, Messrs. Richards & Dole of Springfield, Mass.. have opened a school of Mechanical Engineering, to be conducted in the same building, and in connection with their machinery business. The course of instruction, we are informed, while giving due attention to theoretical knowledge, is eminently practical, and includes all the training and instruction comprised in "learning a trade," as well as a groundwork education in engineering. Instruction is given by lectures and practical illustrations, in three departments, viz.: the school, the experimental laboratory and the work shop. A plan of work has been arranged for the several terms, and a preparatory course for such as cannot enter at once upon the regular studies. The advantages of such a course to those desiring to become skillful draughtsmen or engineers, are apparent, and we trust this, and all similar enterprises will meet with that abundant success that their importance deserves.

The thirteenth annual convention of the American Railway Master Mechanics Association takes place in Cleveland, O., May 11, 1880. The meeting promises to be, as usual, of considerable value to all those interested in mechanical manipulations. The proceedings of the association are published every year in pamphlet form and sold to the public at large. In our issue of June 28, 1879, we gave a synopsis of the proceedings at the last annual meeting. We propose to give as full a report of the next May meeting. The Secretary is J. H. Setchel, Cincinnati, O.

Our readers will find thoughts on friction well expressed in this issue by two practical philosophers, Chordal and Mr. Frank C. Smith (V. Hook). This subject is not by any means exhausted, though mechanics can be found in almost any shop who think they have made some original discoveries in this department.

Present Status of the Edison Electric Lighting System.

In our last issue we advised our readers that we hoped to be able to publish particulars this week of the first indicator test yet made of Mr. Edison's engine at Menlo Park. Although the test has been made, we are unable to give the results this week, by reason of having to wait for revision of the report by each of the four engineers who conducted the test, one of whom lives in Philadelphia, and another in Syracuse. It will appear in our columns at an early date.

The Edison light at present may be especially described as in a transition state. All the lights which began burning January 1st, have gone out, the last one having flickered out two days before our experiments were made. The actual average life of the paper carbon light has been shown by this protracted experiment at Menlo Park, to be 792 hours, or 158 days of 5 hours each—in other words, each light lasts through five months of practically continuous use, as in households. Some of the lights ran up as high as 1,380 hours, while others showed a duration of only 50 hours. These latter cases Mr. Edison claims were due to defective construction, which these very experiments have taught him how to remedy.

The inventor is now using *natural fiber* (such as manila hemp) instead of artificial cotton fiber, in the form of paper, as heretofore, as material for his carbonized loops. The difference between the two substances is analogous to that subsisting between natural wood and compressed saw-dust. In abandoning the carbonized paper loop for a carbonized fiber loop, he does not admit the former to be in any sense a failure, though he does now freely admit that his lighting system was not as perfect in January last, as he then thought it. While not especially dissatisfied with the paper loop, he expects to secure greater uniformity of results from the use of fiber. Having less radiating surface than the cut paper, less power is required to bring it up to the same temperature, or the same power will bring it to a higher temperature, by which means an economy of one-third is known to be gained.

As economy in the production of light by incandescence increases with the higher temperatures, the advantages looked for by Mr. Edison are in the direction of increased light, though at some sacrifice of durability, at the same expense of making. At the same temperature as the paper carbon lamps, he expects the fiber lamps to last 3,200 hours; but the increased temperature, which he desires to reach, will cut down this average to 1600 hours, equivalent to nearly a year of constant household use. Such an average in

a lamp which he hopes to sell for 25 cents, and which can be renewed with all the facility of a kerosene lamp chimney, Mr. Edison claims is high enough for any practical purpose.

But, however sound his reasoning, or confident his hopes, the truth-seeking observer, who wishes neither to be misled by the smiling enthusiasm of the inventor upon the one hand, nor to be prejudiced by street rumors upon the other, is bound to recognize that, for the present, the fiber lamp is still an experiment. The tests of economical production of the light and actual durability of this style of lamp, are yet to come.

LITERARY NOTES.

STEEL, ITS HISTORY, MANUFACTURE, PROPERTIES, AND USES. By J. S. Jeans, Secretary of the Iron and Steel Institute. 860 pages. Illustrated. $14.50. Published by E. & F. N. Spon, New York.

The book referred to is indeed a complete history of the metallurgical operations connected with the manufacture of steel. Reliable information in regard to the different processes has become an every-day requirement. This volume is illustrated by 24 plates, and contains a history of American steel manufacture by A. L. Holley, a well known expert in steel manufacture. The book gives an account of the early history of steel, also of its modern history, marking the progress of invention in steel manufacture, history of the Bessemer, Siemens, Martin, and other processes, fourteen in number. An account is also given of the introduction and progress of these processes in the different European countries. The different kinds of well known steel are described, also the process of manufacture, chemical, physical and mechanical properties.

Copious statistics are given showing the introduction of steel for railway purposes, shipbuilding. boiler and bridge construction, ordnance, armor plates, projectiles, tires and axles. The appendices contain records of experiments, cost of plants, analyses, &c. It would be impossible to give in our limited space a complete review of this book, and we can only skim over the surface. We can heatily recommend this book, and intend to use it as a reference and shall probably make some extracts from it in the future.

Business Specials.

40 cts. a line for each insertion under this head

A "New Pulsometer" Steam Pump—is cheap, simple, durable, and economical. "The one you put in for us is giving entire satisfaction. We believe the Pulsometer to be the best and cheapest pump now in use. J. F. Millemann & Co., Provision Dealers, 211 Washington Street." Send for description and prices. Pulsometer Steam Pump Company, 40 John Street, N. Y.

Improved Work Holder for Lathes, Gear Cutting Attachment for Lathes, Tyson Vase Engine 1-32 Horse Power, New Tools, Chucks, Drills, Lathes. Send for 1880 Catalogue. Jackson & Tyler, Baltimore.

The American Standard of Bolts and Nuts. Full sized drawing, 20″ x 30″. All dimensions and threads to the inch of all bolts in the system from ¼″ to 3″. Price $1. Address, Edward Lyman, C. E., New Haven, Conn.

All kinds machine drawings. Inventors' work a specialty. Hours, 9 to 6. Wm. D. Skidmore, No. 733 Broadway, N. Y.

Mechanical Engineering, thorough instruction, practical and theoretical. Richards & Dole, Springfield, Mass.

For Schaffer & Budenberg's celebrated Steam Pressure, Hydraulic and Vacuum Gauges, Engine Counters, Pyrometers, Thermometers, Reducing Valves, Superior Crystal Gauge Glasses, etc., address W. Heuermann, 40 John Street, New York.

American Watch Tool Co., Waltham, Mass., Lathes, Watch Case, and Clock-Making Machinery.

See Christiana Machine Co.'s adver., next number.

Wilkinson & Crowell, 1201 Beach St., Philadelphia, make an Improved Metallic Piston Rod Packing, which is entirely automatic and of great durability. Works well at high or low pressure, and can be used in common stuffing box, or without any stuffing box at all.

Norris & Rutter, Mechanical Draughtsmen and Patent Solicitors, 424 Walnut Street, Philadelphia.

A new automatic valve gear for steam engines complete. Address, Ed. F. Williams, P. O. Box 148, Leadville, Colorado.

Dies for every purpose. Stiles & Parker Press Co., Middletown, Conn.

Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, 65 Henry Street, Brooklyn N. Y.

James W. See, Consulting Engineer, Hamilton, Ohio.

Car Builders' Dictionary. Now ready. Assigns names to kinds and parts of railroad cars, identifying each. 800 engravings, and 490 pages. Price, postage prepaid, $2. Ten copies to one address, $17.50. Published by the *Railroad Gazette*, 73 Broadway, New York.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co., New York, or the author, Manchester, N. H.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

To Manufacturers and others: We are prepared to build all kinds of machinery. Patent Articles a Specialty. Correspondence Invited. Mather & Newitt, Practical Machinists, Leominster, Mass.

John Fish, M. E. Air Compressors and Working Drawings a specialty. Room 23, 10 Pine St., New York.

W. Barnet Le Van, Mechanical and Consulting Engineer, 3607 Baring Street, Philadelphia, Pa.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) P. H. G., Glen Cove, L. I., asks: How are cams, such as used on the Woodruff Steam Engine valve gear, hardened, without risk of cracking them in the operation? The cams to which I have reference are castings of steel. *A.*—The steel bands used upon the cams of the Woodruff Steam Engine are first turned up, and after heating are cooled off in oil. This process leaves the outside surface very hard, while the inside is softer, and stronger. After hardening, the bands are ground so as to make a good fit upon the cams, and are prevented from getting loose, or slipping by the insertion of screws.

(2) J. F. G. Lockport, N. Y., asks: What reliable, at the same time practicable rule, or proportions do you recommend on which one can construct suitable chimneys for steam boilers on a battery of boilers? I have consulted the works of several authors, but have not been fortunate enough to satisfy myself with a "happy medium," as there is such a wide difference between them? *A.*—There is no reliable, or practicable, rule for the construction of chimneys. The area of cross section of a chimney should never be less than 1-6 the area of the grate surface. The higher the chimney is, the more will the heat be utilized for creating draft. The economy consists in making the chimney high, and reducing the temperature of the ascending gases by absorbing more of the heat for evaporation. Any excess of the draft can be regulated by the damper, therefore it is always better to have a little in excess. 2. Is "friction" to be considered separately as one of the losses in the flow of steam through pipes, or is friction to be considered as only a cause and part of condensation, and included under the head of "loss by condensation?" *A.*—The loss by friction of steam in passing through pipes is a condition entirely distinct from condensation, and has no connection whatever. 3. Is evaporation constant, regardless of pressure, or does evaporation vary with change of pressure? *A.*—Evaporation varies constantly with the changes of temperature of water in the boiler. To understand this requires but little consideration.

(3) S. A. J., Brooklyn, N. Y., writes: 1. Please tell me how to keep the top of the furnace of an upright tubular boiler clean, where there are no handholes—is there any way, or anything to use? *A.*—Tap a number of holes at convenient points, opposite the crown sheet, and insert 1¼″ brass plugs provided with squares by which they may be applied and removed. When the boiler requires cleaning, by simply removing the plugs a scraper may be inserted to loosen the deposit, and by inserting the nozzle of a hose the dirt may be entirely removed. 2. "Gleanings from the Foreign Press" of Jan. 24th, 1880, says, "Never empty a boiler under pressure, but allow the boiler and brick work to cool before running off the water." Bourne, on page 273 of his book says: "Where the fire-box and tubes are of iron there will not be an equal risk of injury"—referring to locomotive boilers. Is it not the usual thing here to blow off boilers under pressure? Please give your opinion with and without brick work. *A.*—We consider it very injurious to a boiler which is set in brick work to blow off the water under pressure, for the reason that the bricks often remain red-hot for some time after the fire has been hauled. If the water is blown out of the boiler while the bricks are so hot, there may be great injury done to the boiler. A locomotive boiler, or those which have internal fireboxes, may be blown off with a low pressure of steam; but our advice is to empty boilers when cold, as blowing off does not clean the boiler, and only removes the loose sediment a short distance from the boiler head. It is customary to blow off under pressure.

(4) E. E. A., Randall Road, N. Y., asks: Will you be so kind as to inform me whether there are any schools, universities, or institutes in the Eastern or Middle States in which a thorough practical course of study, relating entirely to mechanical engineering, is offered to those wishing to become mechanical engineers? And whether this course of study is offered by any institution that will allow a student a compensation for his services while passing through the course of study, which will enable him to pay for his board only? *A.*—We are not aware of the existence of any such institutions as you are in search of. Most of the technical schools, however, make special agreements in reference to tuition. These terms can only be secured by writing to each of the schools referred to, which we advise you to do.

(5) O. L. W., Philadelphia, Penn., writes: Are there any books published which treat exclusively of pattern making? If so, will you please tell me the names of them? *A.*—The Pattern Maker's Assistant, by Joshua Rose, is a very practical work on the subject.

MANUFACTURES.

It has been decided to locate the machine shops of the Peoria, Decatur and Evansville Railroad at Mattoon, Ill., and the necessary buildings will be immediately erected.

N. Dustin & Co., of Dexter, Me., are to build a new machine and blacksmith shop and foundry, thus doubling their capacity.

In connection with their regular business of furnishing expert mechanical and engineering services, Park Benjamin & Bro. have undertaken the agency in New York of the Holly Manufacturing Co., of Lockport, N. Y. at offices, 49 and 50 Astor House. They invite communications from cities and towns contemplating the establishment of water works, and will furnish full particulars regarding the peculiar features and advantages of the Holly system of direct supply.

The manufacture of steam pumps heretofore conducted under the name of A. S. Cameron (deceased in 1877,) in this city, has been reorganized as the Cameron Steam Pump Works, John Matthews, attorney. The business is owned by Mrs. A. S. Cameron.

B. F. Sturtevant is employing 150 workmen, full time, at his extensive blower manufactory at Jamaica Plains, Mass., (office and warehouse, Boston). He turns out about 200 blowers a month nearly half of them weighing six tons each. With the additions lately made to his factory it occupies an acre and three quarters of land. He does all his own boiler work as well as brass and iron casting and is now preparing to make his own steel castings in order to insure their perfect reliability.

The Hampden Foundry and Machine Co., Boston, have just sold one of their feed water heaters to the Massachusetts State Prison to use with a 200 H. P. Corliss engine, also one to the Crosby Steam Gauge Co.

The wages of the employes at the Ballston, N. Y., paper box factory have been raised 15 per cent.

The workmen in the cotton mill at Little Falls, N. Y., have received an advance of ten per cent. in wages.

The Southern States Company, South Pittsburg, Tenn., have started the construction of a second furnace. Two 84x36x48 engines, three Whitwell stoves, 18x40, and ten cylinder boilers, are to be made in England, and the cast house in Pittsburgh, Pa.

Horace Jenckes, of Woonsocket, R. I., has the contract for building the Franklin Beet Sugar Works, seven buildings in all.

According to a recently published report, 1,700 farmers raised the beets used by the Maine Beet Sugar Company last year. The average crop from 100 acres was 9½ tons. For 9,000 tons delivered at the factory, $56,000 were paid; for storing and pitting, $6,000; fuel, $10,000; labor and other expenses, $37,000—total, $107,000. The product, 900 tons of sugar and molasses, brought $110,000, leaving $3,000 toward machinery and fixtures that cost $60,000, to which must be added the State bounty.

The Interchangeable Tool Company has leased for five years the buildings of the steam power company at Milford, Conn., and have about 30 men already at work there.

The Hartford Carpet Company at Thompsonville, Conn., are constantly enlarging. The warehouse and dye-house are approaching completion and several cottages are to be built.

The capital stock ($50,000) is being subscribed for a new jute mill to be built at New Orleans, La.

It is understood that the Saco Water Power Machine Shop, employing about five hundred men, and York Mill, Biddeford, Me., will soon advance the wages of their employes.

The Cuyahoga Works of Cleveland, Ohio, are now erecting one of their new style of 84-inch blowing engines at the new furnace of the Mahoning Valley Iron Company at Youngstown. This is the fourth engine of the kind recently built by them, and they have three more nearly completed for the Union Iron and Steel Company of Chicago.

The Union Boiler Works of New Bedford, Mass., are having a building erected for them, 54 by 27 feet.

The Wason Manufacturing Company, Springfield, Mass., have made a re-adjustment of wages at their Brightwood shops, amounting to a general advance in the pay of the old hands of from 5 to 12½ per cent.

The operatives of the Pepperell and Laconia cotton mills of Biddeford, Me., have been notified of an advance in wages.

The Rhode Island Cardboard Company, Pawtucket, R. I., have the plans drawn for a new factory.

A paper tower, 29 feet in diameter, is to be built at Polytechnic Institute, Troy, N. Y.

The old rolling mills at Dover, N. J., have been set in operation by a new company, after being idle for many years.

A lock factory is in contemplation at Youngstown, O. Mr. Pope, of Chagrin Falls, is the projector.

Mr. E. S. Higgins is about to build an additional worsted mill adjoining the one now in use on Forty third street, New York.

The Cocheco Manufacturing Company, Dover, N. H., is to build another new mill, which, when completed, will make a structure 700 feet long, and will run 56,000 spindles.

On the Ohio & Mississippi Railroad, the wages of all employes were restored on April 1st to what they were before the reduction in 1877.

The striking puddlers at Palo Alto Mills, Pottsville, Pa., have resumed work on the basis of regulating wages in accordance with the price of rails.

The Cleveland, Ohio, City Forge and Iron Company are proceeding with the erection of new buildings on a portion of the site of the old works. The structure will be of frame and in dimensions 100 by 70 feet, and will be used for forge purposes. The works are now running day and night with all the work they can attend to.

A great deal of hard feeling has been engendered among the strikers at Cohoes, N. Y., by the action of the company in retaining two weeks' pay from each employe, on the ground that no notice was given before leaving work. The claim is made by the operatives that over $15,000 remains in the hands of the company by the transaction. Suit will be commenced to recover the amount.

The entire product, in Paterson, N. J., from silk alone, is estimated now at from $20,000,000 to $25,000,000 per year, about two-thirds of the whole amount manufactured in this country.

The Albany & Rensselaer Iron and Steel Company will shut down one of their mills in June for the purpose of making extensive repairs. It is intended that Belgian wire iron will be among the products of the mill when the alterations are completed.

The new cotton factory to be erected at Hamilton, Ont., will, according to present expectations, be completed by September next. The building will front on Mary street, and will occupy ground 104 × 122 feet. When in operation, 200 hands or more will be employed.

Machinists' and Engineers' Supplies.

New York, April 15, 1880.

The general state of the market this week is rather unsettled, which is owing to the decline in the price of iron and other metals.

Iron pipe is discounted all the way from 40 to 50 per cent. from list prices.

Brass and copper pipe remain unchanged, as the prices were not advanced with the late rise in the prices of metals.

There has been a general advance of 10 per cent. on taps and dies. The discount on taps, hereafter, will be 25 per cent. Screw plates have also advanced, and the manufacturers are behind with their orders.

The American Screw Co. have advanced the price of machine screws 10 per cent.

Drop forgings, and other forged goods are still difficult to obtain.

It is reported that the manufacturers of the Horton chuck will soon put a new chuck upon the market.

The price of the B. F. Prentice lathe, built at Worcester, Mass., has been advanced from $150 to $175.

It is reported that the manufactured goods made by the Brown & Sharpe Manufacturing Co. are scarcer at the present time than ever before, which is owing to the largely increasing demand.

The Miller's Falls Company, manufacturers of general hardware and tools, of Miller's Falls, Mass., have just issued a new illustrated catalogue containing 48 pages, which describes the goods manufactured by them, with price lists. Headquarters 74 Chambers St., New York.

Hall's Patent Compound Lever Cutting Nippers, Peter A. Frasse & Co., sole agents, have advanced as per following price list: No. 2—Size 5 inches; Jaws open to cut wire, 3-32 in. diameter, $20 per dozen; extra jaws per doz. $4.50; extra handles per doz. $3.50; for May 1st: No. 4—Size 7 inches; Jaws open to cut wire, 5-32 in. diameter, $30 per doz; extra jaws per doz. $6; extra handles her doz. $5. Nickel Plated—Nos. 1 and 2, extra per dozen, $3; Nos. 3 and 4, extra per doz. $5. There is now only one size manufactured. No. 4 will be ready for delivery about May 1st.

Planished Copper has declined 2c. per pound. We publish the revised lists: O'Neill's Patent Planished Copper, taking effect this day. Net Cash Prices. 14×48—14 and 16 oz. and heavier, 39c.; by the case, 38c. per lb.; 12 oz. and lighter, 42c.; by the case, 41c. per lb. Boiler Sizes. 7 in., 14×52, 8 in., 14×56, 9 in., 14×60. 14 and 16 oz and heavier, 41c.; by the case, 40c. per lb. (And all sizes not over 20 in. wide.) 24×48, and 30×60. 14 and 16 oz. and heavier, 43c. per lb.; 12 oz.; 46c. per lb. Planished Brass, 2c. per lb. less than Planished Copper. Planished Gold Bronze, 3c. per lb. more than Planished Copper.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling slip, New York, furnish us the following, under date of April 15, 1880:

Dullness still continues in Metals, and prices not as strong as a week ago. Pig Tin, in London only nominal, at £83; Singapore, $28; Spot Market without life; Banca, 23½c. to 24c.; Malacca & Straits, 20¾c. to 21c.; Billiton, Australian and Refined, 20½c. 20¾c.; "Lamb & Flag," 20¼c. Pig Lead, 5⅞c. 6c. Antimony, 19c., 20c., and 24c., as to brands. pelter, neglected, 6¼c. for round lots, either Domestic or Silesian. Ingot Copper, 22c.; Nickel, $1.15.; No. 1 Solder, 11¼c. "Half-and-half," 13½c.

Iron Review.

New York, April 15, 1880.

The market for pig iron is very quiet and prices at the present writing nominal. Very little business is doing. We quote No. 1 foundry, $33 to $34, No. 2, $32 to $33, and gray forge, $32. Old rails are offered at the price of No. 1 foundry iron, but there is no considerable stock on the market. Bar iron from store remains about as last week.

Pierson & Co., 24 Broadway, N. Y., under date of April 15th, 1880, quote prices out of store as follows:

Iron Rails, $68 to $70, according to weight; Fish Plates, 3¼c. per lb.; Railway Spikes, 4½c.; Bolts and Nuts, 5c.; Common Bar Iron nominal, 3 8-10c., basis from store; Refined do., 4c., basis; Ulster, 5c., basis; Machinery Steel, 7c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c.; Nail Rods, 7c.; Sheet Iron, 4¾c., basis; Angle Iron, 4 3-10c.; Tee Iron, 4 8-10c; Band Iron, 4 7-10c.; Hoop Iron, 4 8-10c., and up according to size; Horse Shoe Iron, 4½c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers, 10% off in bulk.

Carmichael & Emmens, 130 Cedar Street, New York, quote prices of Boiler Makers Supplies as follows: Flange, 5⅞c. to 6c.; C. H. Shell, 4¼c. to 4¾c.; Tank, 4c. Boiler tubes, 30% to 35% discount from list.

WANTED.

WANTED.—Several strictly first-class machinists. Address Buckeye Engine Co., Salem, Ohio.

WANTED.—A first-class Brass Fitter and Finisher with Fox Lathe, power and room, and steady work guaranteed, either by contract or otherwise. The Miller Company, Canton, O.

Twenty Machinists Wanted, by the Rollstone Machine Co., Fitchburg, Mass.

WANTED—A few strictly first-class machinists accustomed to tool building, capable of fitting up work in a thorough manner. Address Niles Tool Works, Hamilton, Ohio.

A Spring Maker wants situation in locomotive shop to do repair, or new work; fifteen years experience in the Grant Locomotive Works. Address, John Doremus, 971 First Avenue, New York City.

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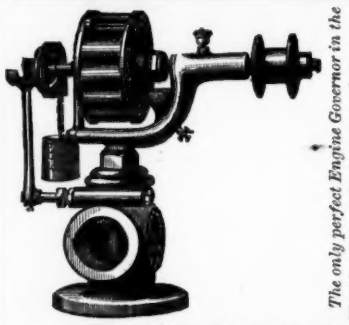

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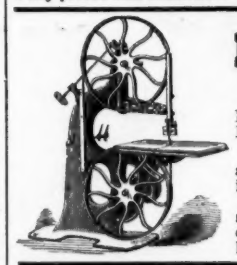

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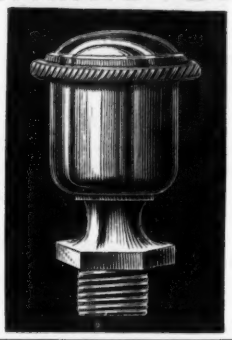

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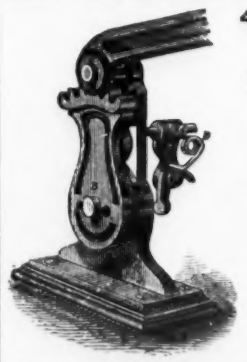

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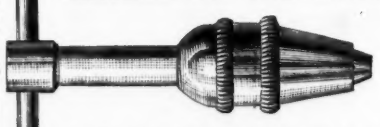

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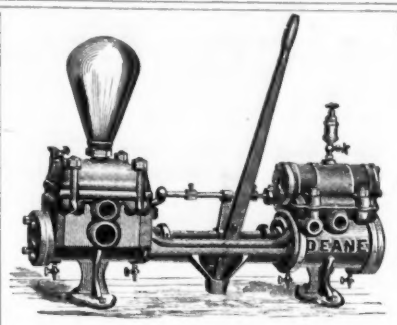

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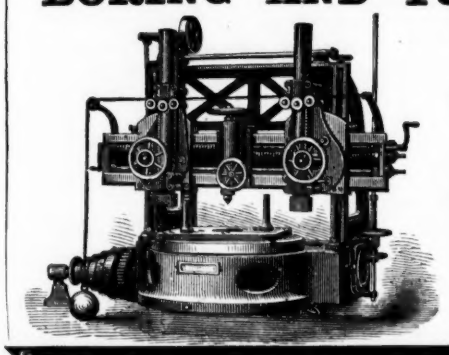

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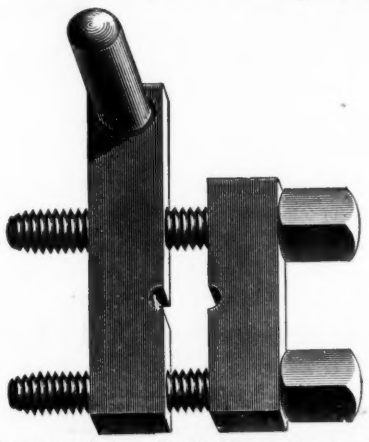

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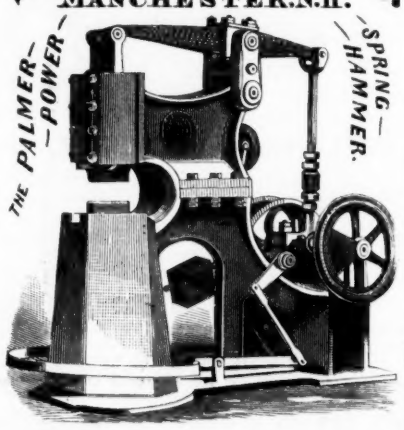

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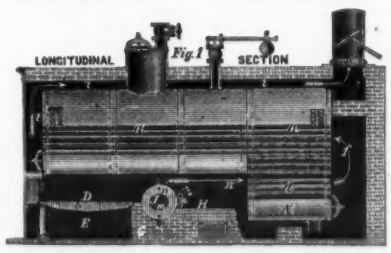

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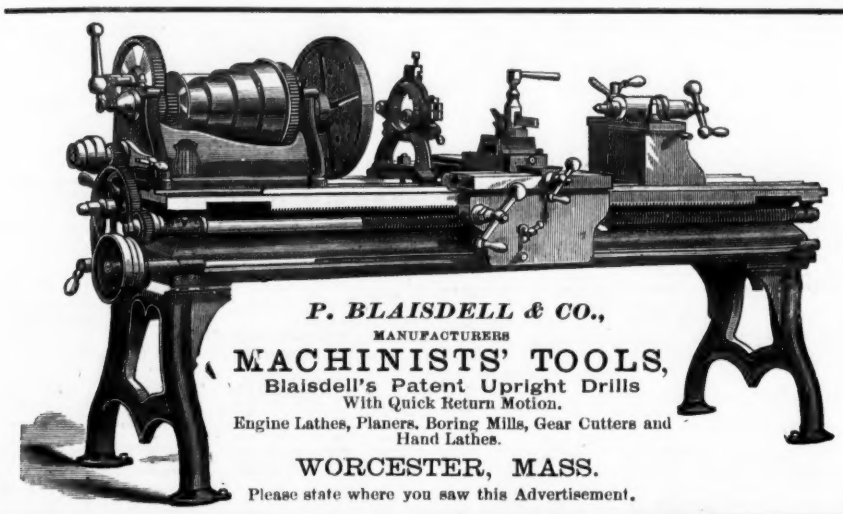

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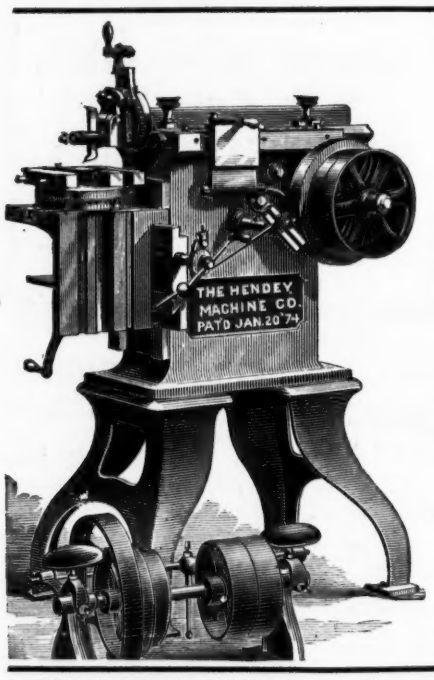

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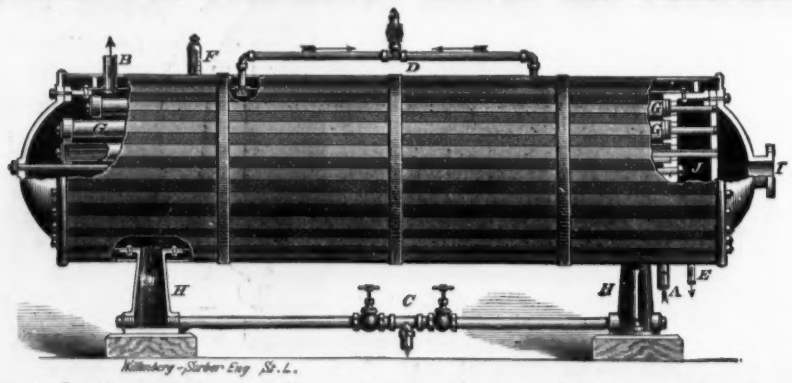

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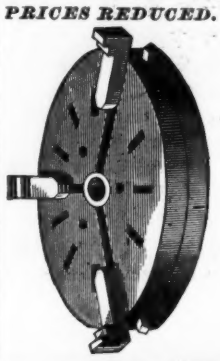

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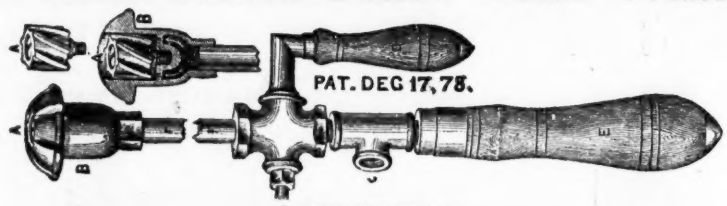

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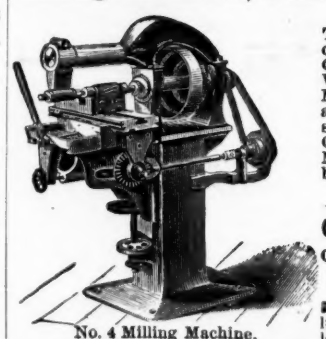

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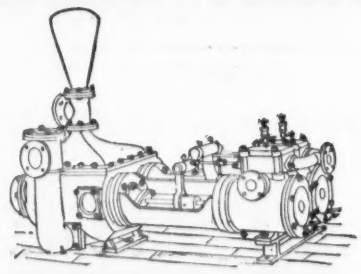

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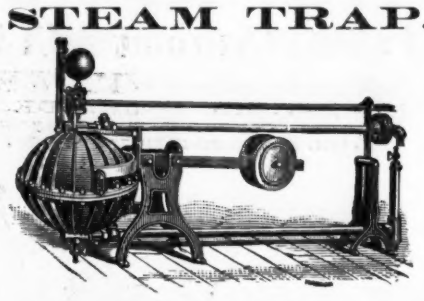

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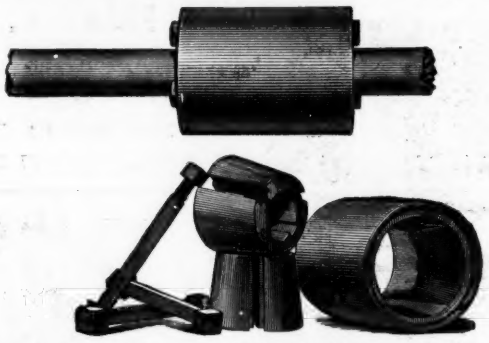

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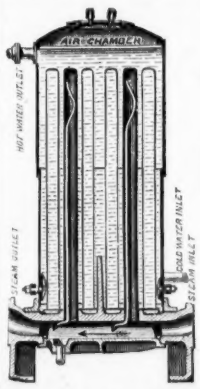

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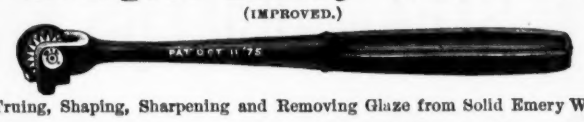

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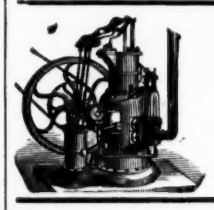

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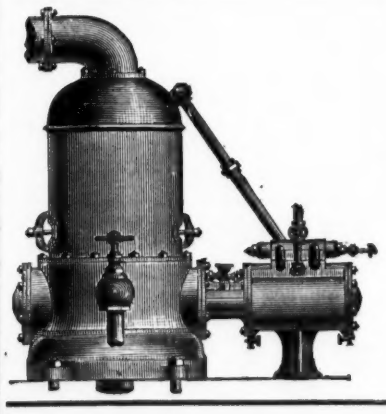

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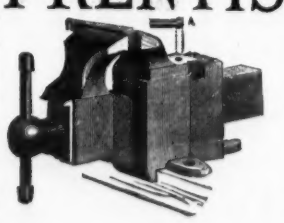

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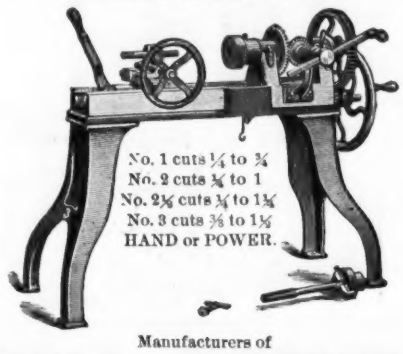

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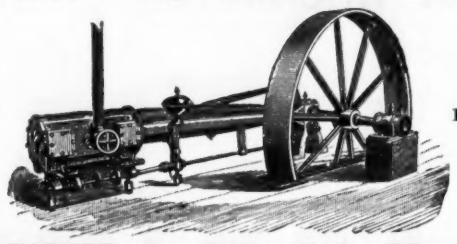

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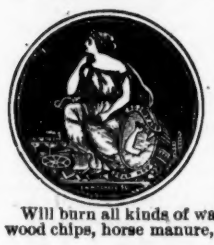

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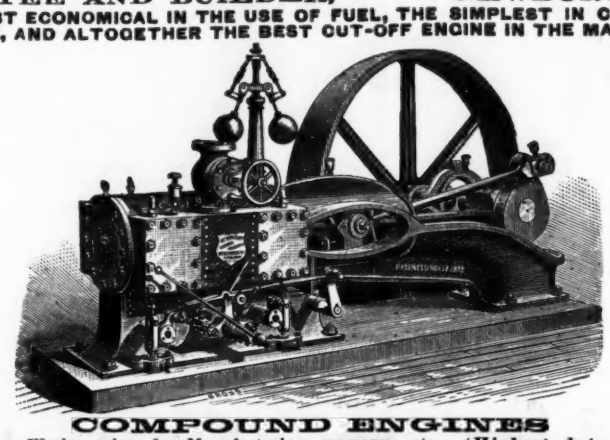

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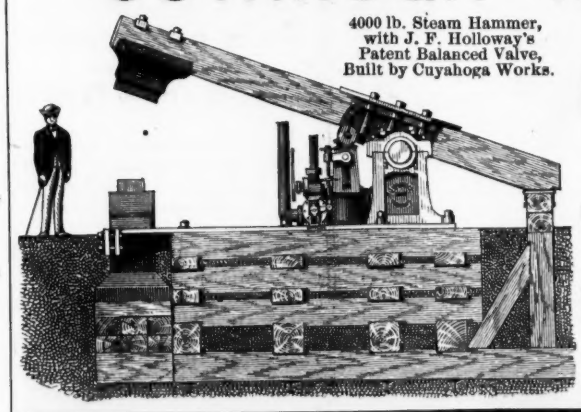

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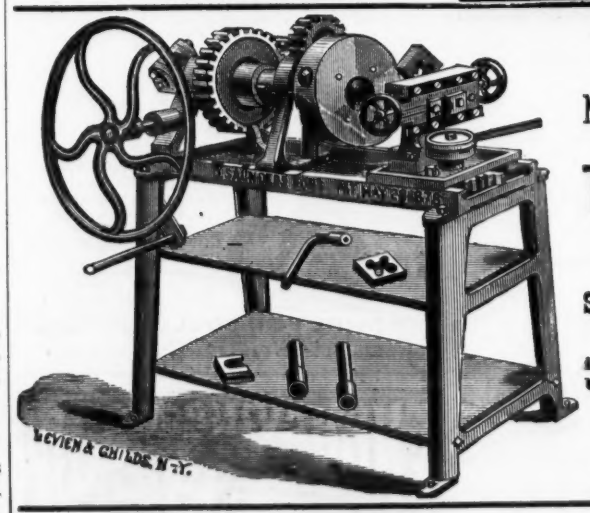

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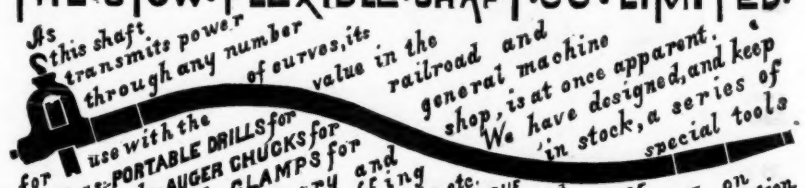
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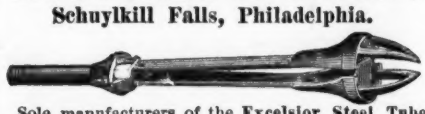
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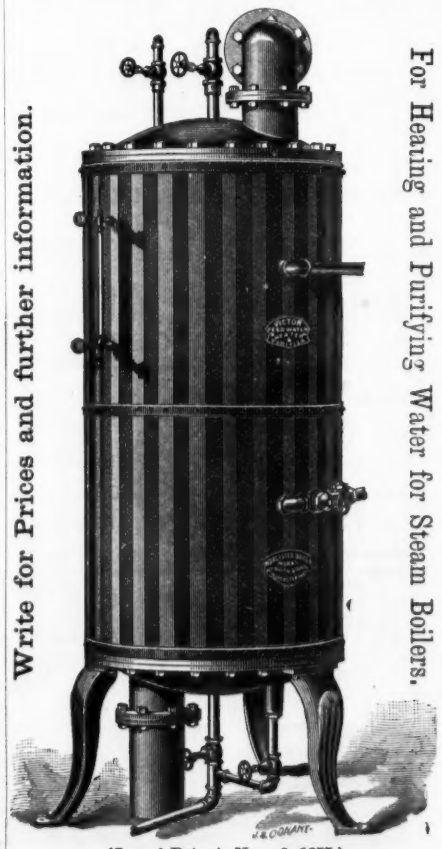
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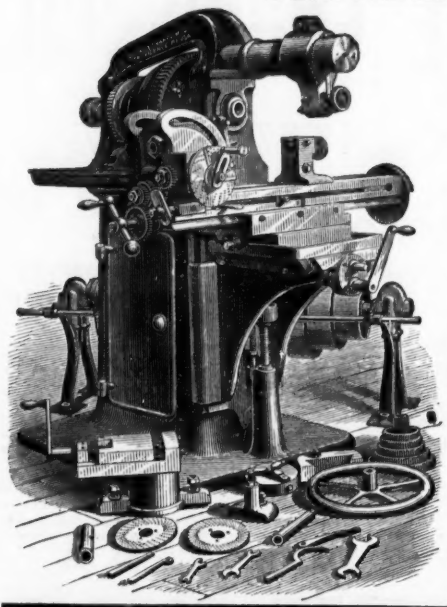

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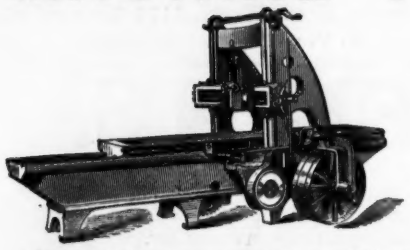

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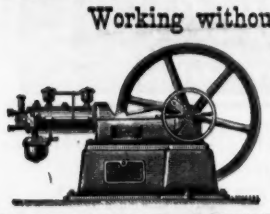

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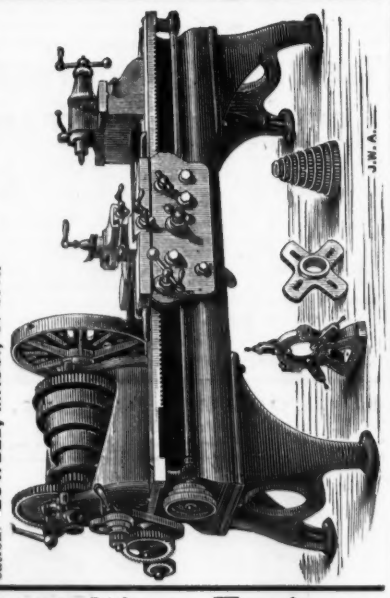

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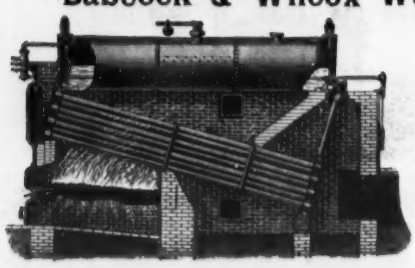

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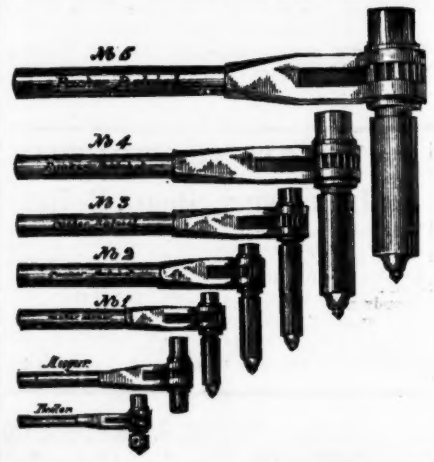

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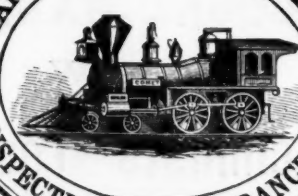

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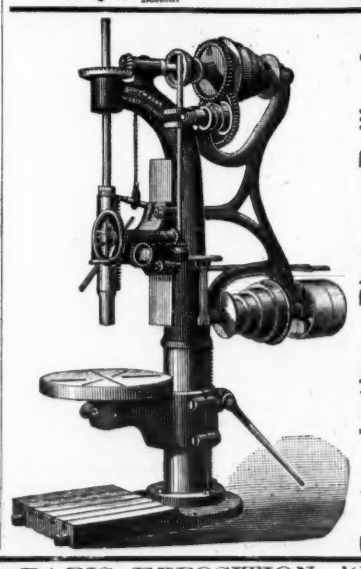

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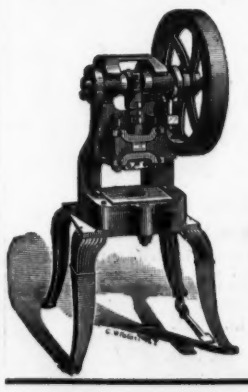

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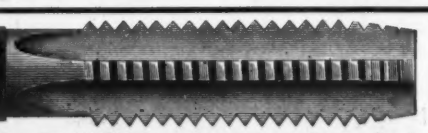

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